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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Cupola Working.

Two Papers presented to the Chicago convention of the A.F.A. recently concern cupola working, and the data given are of interest because the outputs obtained in U.S.A. permit sizes to be used not commonly found in this country. One Paper, by Mr. J. T. Mackenzie, deals with a new type of hot-blast cupola, described as having had over three years' operation. It is stated that only by heavy coke charges and high blast pressure can the demands made on the cupola be met. The scheme is to take air from the windbelt into a hollow casting forming part of the cupola stack and lead it from thence into the tuyere. It is found that iron of ingot-mould composition lasts 75 heats of 20 hrs. each, equivalent to about three months of regular working in the stack castings, which take heat from the rising gases and give it to the air on the other side.

It is stated that to yield 18 tons per hr., the cold-blast cupola had to be blown at 20 oz., and even as high as 24 oz., with a coke ratio of 7.5 to 1, or 13.3 per cent. Such a figure would strike us as on the high side for such long runs as 20 or 24 hrs. 1,430 deg. C. was said to be too low for the work to be poured, and 1,450 deg. C. to 1,460 deg. C. was reached ordinarily. When converted to the hot blast the cupola yielded 20 tons per hr. on a blast pressure of 19 oz. and a coke ratio of 9½ or 10 to 1, or 10 to 10.5 per cent., the temperatures being higher on the whole. A comparison of six months' working shows a coke ratio for cold blast of 7.1 to 1 and for hot blast of 10.4 to 1, the respective blast pressures being 20 oz. and 14 oz., and the outputs being 20 and 25 tons per hr., the average heats being 12 hr. and 18 hr. The blast temperature is said to run from 130 to 150 deg. C.

We are inclined to think that British foundry metallurgists would not regard a ratio of 10.4 to 1 (*i.e.*, 9.6 per cent.), presumably excluding the bed, as sufficient to justify the outlay and maintenance costs involved in a hot-blast equipment, especially when the long runs, which are all in favour of economy, are considered. It is true that the phosphorus does not run as high as is customary over here, being 0.4 to 0.7 per cent., but cold-blast cupolas are working quite satisfactorily in this country with coke consumptions, excluding the bed, of 14 to 1 (7 per cent.), and go, in fact, as low as 16 to 1 (6 per cent.), on comparatively short runs of, say, 4 to 8 hr. Information relating to the coke and other matters may explain the discrepancy, but we have yet to find adequate reason for the complication and cost of hot-blast working justified in the case of an intermittent furnace like the cupola. The second Paper is mainly of interest for the light it throws on the plant covered by the first Paper, and refers to effect of holding charges in the cupola for a period before putting on the blast.

Testing Cast Iron.

Elsewhere in this issue we describe and illustrate a new combination miniature tensile and Brinell testing machine, which is of special interest to the foundry industry because it is capable of registering directly the strength of the individual sections of a casting, or if the section be really deep, its strength from the outside to the core. This feature, which is, of course, related to the rate of cooling, as has been recognised by the Institute of British Foundrymen, the appropriate committee of which stipulated and has had standardised, three test-pieces of varying diameter to take care of the testing of corresponding average sections of finished castings. This involved either the separate casting of test-bars under like conditions, or the addition to the casting of what the Americans call a coupon, but this may be subjected to either a sort of annealing or may "feed" the casting or it may be fed by the casting. Thus the British system, which has our wholehearted support, came in for much criticism from the Continent, where a system of trepanning small pieces from the casting and submitting them to a shear or static transverse test is advocated. The British criticise this by correctly asserting that small tests taken from a casting only represent that portion examined; that inspectors the world over relied on tensile figures for the design of their scantlings, and that no single constant could convert shear test into tensile. Thus it appears to us that the new machine marks a great advance, as it appears to check up with the larger-size tensile machines and it is capable of ascertaining the strength of any portion of a casting within reason. It is not meant to replace the normal methods of testing, any more than a pocket chronometer is meant to supersede Big Ben. Naturally, using a 0.16-in. bar, and assuming the graphite structure to be coarse, we should expect the results to vary somewhat, but, after all, the machine would only be telling the truth, whilst differences from the outside to the core of a large section would also vary, but here again the results are merely in agreement with the thermal history of the cast iron. This, in a nutshell, is the real domain of the new testing machine; that is, ascertainment of strength of members of a casting, leaving proving for acceptance in its present position by means of the larger machines.

The research and routine values of the new machine are such that they should certainly be brought to the notice of the various international bodies charged with the study of methods of testing, for just as there is a need for huge machines capable of breaking lengths of marine cable, so to a means of ascertaining accurately the tensile strength of quite small members of a complex whole is equally a modern requisite of engineering.

XUM

The British Cast Iron Research Association.

IV.—SERVICES RENDERED BY THE ASSOCIATION TO MEMBERS.

Previous articles in this series have dealt with the general progress made by the Association in the past seven years, the conditions of membership and the facilities available for carrying on the work of the Association.

The services rendered by the Association to those firms who become ordinary full members are mainly three in number:—The service of information from the Library and Information Bureau; confidential research reports on investigations in progress, and thirdly, assistance in the application of discoveries made by the Association to particular industrial requirement and the solution of the problems incidental to the production of castings.

Information.

Reference has already been made to the Library and Information Bureau. The latest books, periodicals, patent specifications and trade information come to the Association from all parts of the world, and every addition likely to be of value to the trade is indexed for reference. The Association is therefore in a splendid position to answer inquiries, which can be dealt with by reference to existing knowledge. In order that members shall see what new material is available, abstracts are published regularly in the Quarterly Bulletin. By means of the Information Bureau, the Association is able to keep in touch with foundry developments in all parts of the world. The service is also of great value to the staff, because in undertaking any investigation it is important to know what has already been done in that particular line. The existence of the Bureau makes it unnecessary to duplicate investigations which are carried out in foreign countries and the results of which are published. The Bureau is in charge of a technically-trained assistant, for considerable experience is necessary in distinguishing between work which is new and significant and published matter which is a restatement of what is already known.

Considerable importance is attached to keeping in touch with technical developments in foreign countries, and with the co-operation and interests concerned, materials and processes of interest to the industry, and offered to it, are examined and reported on impartially. The occasional arrangement of visits to foreign foundries may be regarded as an extension of this service, and several of these visits have been held with great success.

Research.

The Association carries out an active research programme, details of which will be given later, at various centres, particularly at its headquarters laboratories, at the University of Sheffield, at the Falkirk laboratory, in the works of members and in other laboratories where co-operation can be arranged. Research Reports are issued as and when complete, and appear on an average about one or two per month. Some are printed for general circulation to all full members, and others of interest to a particular section of the trade or of highly-technical character are issued in typescript and are circulated on request. The issue of these reports is always announced by a circular letter and a complete list for the quarter appears in each issue of the Bulletin. Many of the printed reports are brief and non-technical in character, the conclusions arrived at being given rather than the detailed evidence on which the conclusions are based. The latter is invariably given in the typescript reports.

The Association has evolved what is believed to be a unique method of demonstrating research results to members. Two or three times each year a private meeting of members is held in about ten of the large industrial centres, and matters of interest to members and work in progress is discussed and illustrated, as occasion demands, by demonstrations, lantern slides, samples, etc. The Research Committee is always anxious to consider suggestions made by members for the research programme.

Development.

The Association has always recognised, from the earliest days, the importance of what is briefly termed industrial development; that is, the application of results obtained in the laboratories to industrial practice. Frequently this process involves just as much work as the conduct of the original investigation, since the requirements of particular applications vary so much. The Association's interest in improving cupola practice is due not merely to the desire to economise in the production of molten metal and to improve its temperature and quality, but also to the realisation that the properties of the ultimate casting are governed to a very large extent by the conditions of melting in the cupola. Again, the problem of producing sound castings with a suitable surface is very largely governed by the nature and the treatment of the moulding and core sands employed. The range of problems submitted by members is very wide and covers pig-irons and scrap, fuels and fluxes, sands and refractories, gating and running, casting design, melting equipment, annealing and heat-treatment, and so on. These problems are treated as confidential and are only known to the laboratory staff by numbers. The reports are based not only on sound practical experience but on the latest scientific information available. Visits are paid as and when desirable to members' foundries, and the staffs of member firms are cordially welcomed at the laboratories.

The annual subscription in respect of the above service is inclusive, and from the point of view of Income Tax is, by arrangement with the Inland Revenue, treated as a business expense.

It will be seen from the above that the Association works in the closest touch with the industry, and is in an excellent position for estimating the lines along which research will prove most valuable. It is the constant effort of the Council to increase the services rendered as the income increases.

The dies of die-casting machines may be protected from molten metal by graphite oils, clay washes or mica preparations.

Influence of Mo on Tempering Temperatures.—Mr. L. W. Spring, the author of the American Exchange Paper—"Some Considerations and Tests for Cast Materials for High-Temperature, High-Pressure Service" informs us that the data presented in Table IV (page 10 of our issue of July 2 and also the preprint) have reference to a steel of the following composition, C 0.40; Si 0.33; Mn 0.59; S 0.011; P 0.023; Cr 0.80; Ni 2.07 and Mo (added) 0.29 per cent., and not to the Molybeniferous iron detailed at the base of this table.

B.S. Specification for Rainwater Pipes, etc.—A revision of the British Standard Specifications for Cast-Iron Soil, Waste, Ventilating and Heavy Rainwater Pipes has been issued in one volume, as British Standard Specification No. 416—1931, which supersedes the two specifications Nos. 58 and 59, first issued in 1912. The pipes and fittings as specified will satisfy the requirements of the London County Council Drainage Bye-laws and the Model Bye-laws of the Ministry of Health. The specification provides for three grades of pipe, enabling the architect or engineer to specify the appropriate grade for his purposes. Copies of the new Specification (No. 416—1931) may be obtained from the Publications Department of the Association, 28, Victoria Street, London, S.W.1. Price 2s. 2d., post free.

Random Shots.

Shakespeare, as Mr. George Bernard Shaw graciously points out, was a writer who lived three hundred years before George Bernard Shaw. And now Mr. A. S. E. Ackerman, a consulting engineer, and author of "Scientific Paradoxes," has demonstrated that the plays accredited to Shakespeare should rightfully be credited to Mr. Shaw. Proof of this statement is contained in an arranged list of eleven plays, thus:

Mac Beth.
Oth Ello.
Comedy of Er Rors.
Merchant of Ve Nice.
Coriol Anus.
Midsummer Night's D Ream.
Merry Wives of Win Dsor.
Measure for Mea Sure.
Much Ado About Not Hing.
Anthony and Cleop Atra.
All's Well that Ends Well.

* * *

All's well that ends well, yes; but Mr. Shaw may object to having inferior work foisted upon him as his own!

* * *

Here is the story of Jock the bridegroom. On the first day of his honeymoon he bought a sixpenny packet of chocolate, a small square of which he gave to his bride. The remainder he put in his pocket.

Later in the day the bride said: "Jock, d'ye think ah could have a wee bit more of that chocolate?"

"Na, na," exclaimed Jock, "we maun think of the future. That chocolate is for the bairns."

* * *

When the film "Whoopee" was first shown in New York, two North-American Indians, resplendent in eagle-feathers, wampum and war-paint, were stationed outside the theatre as an advertisement to the show.

An inquisitive woman stepped from the queue to accost one of the Indians, and asked him of him: "You are a real Indian, aren't you?"

"Yes, madam," was his courteous reply.

"And how do you like our city?"

"Very fine, madam. How do you like our country?"

* * *

One of our oldest political clubs until recently was plagued by two members who delighted in nothing better than looking on at a game and making "helpful" comments. They attached themselves one evening to a couple of card players, one of whom, after enduring the nuisance for some little while, rose and asked the first onlooker to play for him until he returned. The onlooker took the cards; the player left the room.

A few moments later the second player followed the example of the first. The substitutes had played for half an hour or so when one asked a steward where the two original players were.

"In the next room, Sir, playing cards," was the steward's reply.

* * *

You may not, perhaps, have heard the story of a distinguished surgeon who had just finished a serious operation on a patient.

"What did you operate on him for?" asked a friend.

"A hundred guineas," was the reply.

"I mean what did he have?"

"A hundred guineas."

MARKSMAN.

Correlating the Foundry Industry.

Mr. L. H. Pomeroy's address* to the annual meeting of the Institute of British Foundrymen on the question of "The Relationship between the Engineering and Foundry Trades" gave rise to an interesting discussion, which helped in a large measure to reveal the foundry industry in its proper perspective. It was opened by MR. JAMES MCLACHLAN, who, remarking that the great interest of the Paper was further enhanced by its distinctly provocative character, directed criticism to some of the statements made in it. In the first place, he drew attention to the author's statement that not only were some designers resentful of being told that an apparently clean and beautiful piece of design could not be produced, but that often, where outside foundries were concerned, the anxiety to get orders was such that work was undertaken which was doomed at the outset to a high percentage of waste and loss to both customer and supplier; further, that foundry experts were often very clever men who made outrageously complicated castings. His comment on this was that it was the engineering designer who designed outrageously complicated castings, and the foundry experts who endeavoured to simplify them. As to the author's statement that whereas there had been great improvement in the performance of the petrol motor, and great improvement in the mileage of tyres, one looked in vain for corresponding improvements, metallurgical or otherwise, in any of the ferrous castings used in a motor car, Mr. McLachlan suggested that the improvement of the performance of a petrol motor from about 20 to 100 h.p. per litre of cylinder capacity was due largely to metallurgical improvements.

American Conditions Compared.

He did not think it was sound to argue, as the author had done, that whilst the American industrial worker had a definitely larger margin for saving than the worker in England, this margin, and far more, disappeared in the purchase of wireless sets, fur coats, automobiles, vacuum cleaners, etc., so that when the pinch came, as during the last year, the American workman and his family were definitely worse off than the workman in England. Mr. McLachlan's point was that if the American workman were as thrifty as the English workman, then obviously the American's standard of living would be higher. The American earned more and spent more; his standard of living was more luxurious, which was his own affair.

Discussing the author's references to the position of motor-car and other manufacturers in the United States, he said he had always been under the impression that the huge home markets open to American motor-car manufacturers had placed them in a very favourable position when competing with British manufacturers for world trade. Much credit was due to British motor-car manufacturers for the leeway they had made up by good design; but, on the other hand, having regard to the traditions of the British engineering industry and the long experience we had had, it did not appear that the Americans should have made the great progress they had, even though they were helped by their large home market. It would appear that in the past the British manufacturer had not been so enterprising as his American competitor. Recently a well-known motor trader, who was extolling the virtues of a car lately placed on the market, had said that it was a British car with an American performance. That was a terrible reflection upon British cars. Undoubtedly British manufacturers made good cars. He did not think that the British foundryman or metallurgist was to blame for the fact that the British motor-car industry was not in the same happy position as the motor-car industry in America; the trouble was largely that the British motor-car manufacturer had not been so enterprising in the past as his American competitor.

Silent Acquiescence Denounced.

MR. POMEROY, replying, agreed that foundry gymnastics had to be resorted to because of the complicated designs put forward by engineers. It was his complaint that the foundryman, instead of exhibiting his strength of mind and saying that he would not make such castings if unduly complicated, would try to make them and would then say, "Look, what a good boy I am." Thereby the foundryman ruined the whole thing. If, when asked by an engineer to make a casting of unduly complicated design, the foundryman would say that it could not be done, he would be surprised what the engineer would do in the way of exercising his brains. Very few people, of course, would really exercise their brains unless forced to.

Commenting on his statement that in twenty years the performance of a petrol motor had been improved from 20 to 100 h.p. per litre of cylinder capacity, but that one looked in vain for corresponding improvements in the ferrous castings used in a motor car, he said it was interesting to note that there had been very little call for what might be referred to as the extra-metallurgical resources of the last twenty years. For example, to consider the connecting rod; ten or fifteen years ago the idealistic engineer had specified that it should be made in nickel-chromium steel or some other high-class alloy, whereas to-day, because of the fact that rigidity, rather than strength, was the property that counted, similar rods were being made in ordinary common low-carbon steel, and would perform quite well. He had been an apprentice in a locomotive shop when mild steel was becoming fashionable, and there had been a good deal of trouble at that time with connecting rods. An old blacksmith had said that if the rods had been made of hammered iron the troubles would not have occurred, and he (Mr. Pomeroy) was not sure that that blacksmith was not right.

American Conditions.

Commenting on Mr. McLachlan's remarks concerning the thrift of the Englishman as compared with the American, he said that such considerations gave rise to all sorts of economic complexes, and, of course, if everybody were really thrifty we should all be ruined. For example, there was no real reason why we should not all dress in suits of overalls, costing about 7s. 6d.; we should be just as healthy as we were in tailor-made suits. We all spent a lot of money on luxuries, and the trouble in America was that they had anticipated about eight years' requirements; then something had happened, and a result was, he believed, that one of the most prosperous industries in America was the selling of apples on the sidewalks of New York. The American method—the competition between Mrs. Jones and her neighbour, Mrs. Brown, and the fact that a man could buy a motor car and various luxuries—led to a habit of thought and conduct and social life which did not, apparently, bring about that security which our old-fashioned methods did. The motor industry provided a good example of that; last year the American output of motor cars had been reduced by about 43 per cent., as compared with the previous year, whereas the English motor-car output had fallen by only 4 per cent. So that our motor-car trade was a relatively busy trade. The only unfortunate thing was that we had found out how to rationalise and to employ fewer workers.

The point he was trying to make, in the Paper, was that any country which had satiated her own requirements sought foreign markets. Undoubtedly, America was seeking foreign markets, especially for motor cars; the position in regard to the production of machine tools, ships, electrical apparatus and other heavy engineering products was that the high-wage rates paid in America constituted a handicap. It was all very well to grumble that the British motor car was not exported in great quantities, but the ability to export competitively depended upon the existence of a home market. The manufacture of the motor car was taken up in America because there was a domestic demand; because of the demand, prices fell, and for that reason America could export cars. We in this country were beginning to create a home market, and our prices for motor cars—though our cars were not of the same type as the American—were becoming competitive. In a country in which petrol could be bought at 4½d. per gallon one could sell motor cars which could not be sold in England, where we were recently paying 1s. 4½d. per gallon. In the Dominions, where petrol was relatively expensive too, the American car had not the same appeal as had the British to a man who wished to run a vehicle economically.

One should not take too seriously the statement concerning a British car with an American performance. There were two lines of thought. The British were a speedy race generally, and many of them wanted motor cars which would travel fast. On the other hand, there were many family men who wanted motor cars, and they did not wish to, and could not, travel very fast. The latter type wanted the lazy man's car, which could be driven without doing the things inherent in the British motor car.

Difficulties in Improving Cast Iron.

MR. J. R. HYDE claimed that by reason of the improvements effected in steel as the result of alloying and heat-treatment the motor-car industry had benefited tremendously. Again, aluminium, as the result of alloying, was made the base of some very useful compounds, and heat-treatment had been applied successfully to aluminium alloys. Cast iron had also been the subject of considerable research. The most interesting committee on which he had served was the Institute's Cast Iron Test Bar Committee, and one of the things which had had to be admitted, very reluctantly, was that the raw material—pig-iron—had not been improved during the last 160 years. He was afraid that, in order to get greater production from the blast furnace, the blast-furnace manager increased the blast temperature, and the iron produced did not give better tensile or laboratory test results than the irons of earlier days.

Foundrymen and metallurgists, however, had done a great deal of work with a view to improving iron. During the last twenty years founders had made motor-car cylinder castings—possibly due to the use of oil-sand cores—in a manner our grandfathers would never have dreamed of, and altogether, through the activities of the Institute, tremendous advances had been made in the use of the material which the blast-furnace manager provided. It was said that ironfounders should put steel into the cupola, but the founders could not get quite the improvement which the engineer would be led to expect. They had effected considerable improvements in castings during the last twenty years, however, and he claimed credit for that, and also for the fact that, due to their improved methods, they were able to work to much closer limits than formerly. It was unfortunate, however, that cast iron did not respond to heat-treatment as did steel, unless malleable cast iron was admitted into the argument.

MR. POMEROY said he was prepared to give the founders full marks for the improvement they had effected in cylinder castings. He remembered the time when 97 per cent. were scrap, but nowadays the percentage had become inconsiderable. The engineers were grateful to the founders for what they had done, but wanted more; they wanted surface hardness, machining qualities and all sorts of things.

* See our issue of July 9, pp. 25-27.

Mr. W. R. Wilson agreed that co-operation between the designer and the foundryman was very necessary, but pointed out that the advantages of it could be nullified by the costing system. He had known cases in which designers had converted the foundryman to simplification in respect of certain jobs, but, due to the costing system adopted, no further advance had been made in that direction. There was a practice in some of the non-ferrous foundries to charge a certain price per lb. of castings, the price depending upon the analysis of the metal, and, no matter whether a casting was a plain, flat one or a very complicated one, the price per lb. was the same.

A Question of Publicity.

Mr. W. T. Griffiths said that he was encouraged to take part in this discussion owing to the reference which Mr. Pomeroy had made in his Paper to the nickel companies, with which the speaker was privileged to be associated. If he read Mr. Pomeroy's Paper correctly, he understood him to say that what we were needing in this country was first of all an increase in our knowledge of the materials with which we were dealing; secondly, an application of that knowledge to foundry practice; and thirdly, the letting of the engineer know that the improved materials or methods due to the application of that knowledge were now at his disposal. He suggested that in this country there already existed the mechanism by which most of these problems could be solved and felt sure that Mr. Pomeroy had a very good idea how these could be solved. For example, in regard to research, we had in existence the Research Association, the staff of which was spending its whole time in improving our knowledge of cast iron. The application of that knowledge to foundry practice was also part of the work of the Research Association, while it formed part of the work of the Institute as well.

The spreading of the information from the foundry to the design engineer and the production engineer was not such a simple problem. The Journal of the Institute and those of other societies were, of course, assisting in this direction, but he agreed with Mr. Pomeroy that more might be done to let the engineer know, firstly, what the foundry could do, and secondly, what it could not do.

The question was one to which a great deal of attention had been given by his own company. As some persons knew, besides maintaining the large laboratory continually on research into the properties of the alloys of the metal with which they dealt, they also had a staff which was engaged entirely in applying those properties in engineering works and discussing with engineers problems involved in the application. In addition, considerable importance was attached to the bringing of knowledge to the notice of all who might make use of it and by means of publication and advertisement, combined with the previously-mentioned development work, endeavour was made to get the properties of the metal and its alloys used in the most beneficial direction.

Improved Personnel Required.

It was, of course, not possible for the foundry industry as a whole to do what a single company was doing for a single metal, but undoubtedly, as Mr. Pomeroy indicated, much more could be done than was at present to ensure that the engineering industry was making the fullest use of the foundry and in the best way. While the Institute could help in spreading knowledge by means of its Journal and by the meetings between its members, something more was necessary to bridge the gulf which tended always to exist between the metallurgist and the engineer. Mr. Pomeroy undoubtedly placed his finger upon a considerable need of the moment when he referred to the demand for men who, while being foundry experts, were also sufficiently cognisant of the engineer's requirements and way of thinking to be able to explain in terms that the engineer could understand exactly the part which the foundry could play in solving his problem. Mr. Griffiths thought it was worth while the Institute considering whether it could do anything to meet this need for what might be termed "bridge men," men who were both metallurgists and engineers and who could appreciate the problems of both. He thought that perhaps our educational system, and by that he meant the system of education inside the works as well as in our schools, technical colleges and universities, was not the best for developing such men, and it might be that the Institute could do something to improve matters in this direction. He felt sure that Mr. Pomeroy's Paper contained food for thought for all the members of the Institute, and he owed him a debt of gratitude for presenting it at one of their meetings.

Industrialisation of Research.

Mr. Pomeroy, supporting the plea for research, urged that it was essential that it should be done with some idea of what the customer wanted. He had seen a great deal of metallurgical research done in problems which were interesting, but the users of the materials were not worrying about those particular problems; there were other problems in metallurgy which were of more concern to them. That was why he had stated that it was easy for the investigator to find what he was seeking and to develop means for stopping the flow at the spigot whilst the precious fluid was running out at the bung.

Overall-Price Castings.

Mr. John A. Smeeton said that although many people seemed to think that foundrymen could not make good castings, very great progress had been made in the engineering industry during the last thirty years, and particularly in connection with the internal-combustion engine, and it was astonishing that engines, such as those made today, could be produced, if the foundry trade were in such a bad state as seemed to be suggested. The foundry could, and did, make good castings, even though it was supposed to be the Cinderella of the industry. There was not a single thing which the foundries had been asked to make which they had not succeeded in making, and foundry work in England was as good as that in any part of the world. He was convinced that, especially in view of the research work which was proceeding, not only in the laboratories of individual foundries but also under the ægis of the British Cast Iron Research Association, British foundries would still be able to produce in the future any castings they were asked to produce.

A difficulty was that castings were only too often bought and sold by weight. As a result, if a jobbing founder were asked to adopt some process for improving the quality of his castings he might, and often did, reply that he was out to sell castings by the overall price per ton, and that if the process in question were adopted by him his output, in terms of weight, would probably be reduced considerably. A founder should be encouraged to sell special castings by the piece which should be as light as possible and have the best physical properties; then he would be more concerned with research. Mr. Smeeton hoped that before long foundries would be able to sell their high-class complicated high-purpose castings per piece and not per cwt. Then the castings would have thinner sections, the users of the castings would have less machining to do, and, so far as good physical properties were concerned, they already existed. Engine castings produced in this country had good machining properties; this was proved by the fact that British motor cars, motor boats and aeroplanes had won all the principal international speed contests, and our engines were equal or superior to any others in the world. Discussing test values, he said that a body of men sat at Westminster and talked about tensile strengths of 6, 8, 12 and 14 tons per sq. in., whereas the founders had long been producing cast iron having tensile strengths of 22, 24 and even 26 tons per sq. in., and would supply it to anyone who would pay for it. It was not sold at the same price as the 10- or 12-ton tensile material.

Competition from Weldings.

Another problem to be faced was the growing tendency to build up composite bodies to take the place of castings. Whenever he visited a large engineering works in this country he noted the increasing tendency to build up shapes by welding, and welding had made enormous progress during the past two or three years. It was said that in the composite articles lightness was combined with strength, but he was quite sure that castings of any shape could be produced, of greater strength and consistency than the composite bodies, and the founders could only blame themselves if they did not discourage the idea that they could not make good castings of high tensile strength and with an analogous degree of lightness as the composite bodies. Mechanisation of foundries was proceeding all over the country, in some cases, perhaps, slightly too much, but for mass production and heavy production we must mechanise. If only foundry machinery were treated as real workshop machinery, and maintained and constantly improved as was the equipment of the machine shop, the foundries would produce, at low cost, all that the engineers called for.

Mr. Pomeroy agreed with Mr. Smeeton's remarks in putting the case for the heavy foundry art, but joined issue with him concerning his remarks as to selling at a price per piece. Mr. Smeeton underrated the intelligence of the engineers very much if he imagined that they were concerned mostly with the price of the casting only; they were concerned with the cost of the finished article, and if the foundryman could say that, by adopting another system of payment or other commercial arrangements, he could save the engineers money, it would be more than surprising if they did not take advantage of it. One of the pleas put forward in the Paper was that the foundryman should tell the engineers about it. He had been concerned with the largest aluminium foundry in the world, but he had never known it to accept an order on the basis of a price per piece. There was such a thing as the rapping of the core.

Where Progress Has Been Made.

Mr. John Shaw stated that Mr. Pomeroy had no doubt a definite object in making the provocative statements contained in the Paper. At the same time, he would like to assure the author that great improvement had been made in our knowledge of the properties of cast iron. To quote a few, good test results gave no evidence of better knowledge, but accidental better irons. One can by this standard only arrive at a conclusion that in 1857, when the British Association conducted tests on sixteen different irons, and the highest tensile result was only 18,855 lbs. per sq. in., that practice had deteriorated since 1783. It would be just as futile to say no advance had been made in steel practice, because the temper and edge on the old Damascus or Ferrara swords had never been excelled, if equalled. Concerning the importance of the tensile test, there is no doubt that in the thin castings named, even the small $\frac{1}{4}$-in. dia. bar would have an entirely different structure from the $\frac{1}{16}$-in. thick castings, and that the tensile strength of the latter would be higher if the cylinder was machinable, the cooling rate being the dominant factor in this case. But the contrary would be the case in thicker castings of the Diesel type. At the same time, there was a real danger in the craze for abnormal tensile results for some classes of work, of which the turbine casing was an example. This high-test metal was so close in structure that it had not that small amount of "give" necessary to adjust itself to a comparative small difference in the temperature gradient between the outside and inside of the casting without slight fracture.

Mr. Shaw was very pleased that Mr. Pomeroy had drawn attention to the need for rigidity to keep alignment and prevent wear. Although at times this necessitated thickening up the casting, it must be remembered, even if this thick portion yielded a lower tensile result per square inch, owing to its greater area, it was stronger than the thin strong section.

The speaker was also in agreement that too much time was spent on academic research, and that most investigations should have a definite and commercial basis. Dealing finally with mechanisation and mass production, he said that Mr. Pomeroy's firm was self-contained, and anything saved in their foundry was for the common good. But founders who were competing with one another in supplying the trade were in a different position. Suppose a founder, by installing new machinery, could increase production and lower his selling price, would Mr. Pomeroy's, or indeed any, firm give the founder an assurance of orders that would not only pay for the outlay, but eventually yield a profit? Or, having forced his competitor to do the same, if he is to stop in business, would not both founders still be at the mercy of the buyer, with an increased overhead as well? So his final state would be worse than his first.

Automobile Buying Practice.

MR. CAREY HILL said there seemed to be a misconception in some minds as to the methods of charging for castings. Castings in aluminium, iron and various alloys had been sold to the motor and other trades on the basis of a price per piece. He had not been concerned with cast-iron cylinders for a long time, but 20 years ago his company were selling them at a price per piece. Certainly, for the last five or six years castings had been sold in mass-production quantities at a price per piece, and he did not think that any respectable buyer in the motor-car industry would buy such aluminium castings on any other basis. If foundries which occupied what might be called sheltered situations within the organisations of large engineering works could come out into the cold and wintry blast of competition in the motor trade, they would probably discover facts which apparently had not yet reached even Mr. Pomeroy.

MR. POMEROY suggested that one of the troubles which Mr. Smeeton might experience when buying castings by the piece was that in order to estimate the price per piece one must have some idea of the weight, and his experience of weight calculations was that they were invariably somewhat inaccurate. He would hate to have to produce a 50-ton casting to within plus or minus 5 per cent. of its proper weight, and a difference in weight might make a serious difference in price. It was a fact that, whilst aluminium castings particularly might be sold by the piece in some cases, a vast number was sold at a price per lb.

A Basic Industry.

MR. E. PLAYER said there was one very important person who ought to have figured prominently in the discussion and in the Paper, but who had been referred to very little—perhaps as much through fear as through respect—and that was the buyer. Mr. Pomeroy's Paper, and his answers to the various questions raised, indicated that, despite some acidity on the surface, he had at heart—"basically," one might almost say—a sneaking sympathy for the foundry, and even a faint tincture of admiration. At any rate, Mr. Player hoped that was so. With the President's permission, he would like to refer to the foundry industry as the foundation-stone of engineering. Like all foundation-stones, however, founders were hidden away; they had a devil of a weight on their backs, and very little ornamentation—and it was not the practice even to bury a few odd shillings with them. Mr. Pomeroy had clearly established the necessity for closer co-operation, meaning in essence a greater mutual trust—which is lacking to-day—between the engineer and the foundryman. It would be agreed that that was very desirable indeed, but by some means or other the buyer must be brought into this.

With regard to rigidity, he agreed that alloys which were rigid, and had exceptionally good casting properties ensuring a more than normal freedom from local cracks and porosity, were to be preferred to alloys having better physical properties in the test-bar, but liable in the casting to produce local weakness due to hot-shortness or shrinkage.

MR. POMEROY, as one who had sold a great many castings in the course of his career, agreed with Mr. Player's remarks concerning the necessity for giving due consideration to the buyer. He added, amid laughter, that a maxim of the company with which he was connected had been "Count each day lost when the setting sun sees castings sold for cost or business done for fun."

Personnel and Progress.

MR. HORACE J. YOUNG wrote that he had met no Paper which interested him more than did this one. Obviously the task of the metallurgist was to provide castings which would be successful *under service conditions*, and to have to deal with directors and experienced engineers in the knowledge that they do not require scientific talk, but want somebody who can apply science economically, practically and successfully. It is to be recognised, however, that it is not always the case that, in a works, the directors confine themselves to directing, or the engineers to engineering, or the founders to founding, or the metallurgists to "metallurgising." Too often is nobody kept to his job and made utterly responsible for its success. It would be good if each metallurgist was put to work on the understanding that he had either to do his job or to get out, and having behind him the managing director's promise that it will not be his fault or that of any of his managers if the metallurgist is unsuccessful. Given these conditions, the metallurgist either is successful or else gets out—generally the former if he is any good.

It would seem to be true that if the engineering trades began to insist upon *apparently* unreasonable specifications on castings, progress would result. For instance, the cast-iron test-bar cast separately from, or attached by stilts to, the casting is different in grain size; composition; microstructure; tensile; transverse; impact; resistance to wear, to corrosion and heat; indeed, it is different in every way from the metal of the main casting. For many years the writer developed irons in connection with large marine Diesels and cut all his test-bars out of the heads of the castings. In similar manner, he took test-bars from extended flanges of other castings, such as turbines, so that he knew pretty well that the material of which the test-bar was composed was actually that of the casting going into service. The practical results of so doing were rather remarkable in that very considerable and constant advances were made.

Looking back upon past problems, it would not seem impossible to discover cast irons to resist pressures in the order of 1,000 lbs. per sq. in. without increasing the wall thickness or to produce alloys to resist the wear of modern brake-lining fabrics. On the other hand, those trying to do these things or appointed to do these things must, at the same time, possess a commercial and practical outlook as well as a scientific knowledge and experience of matters metallurgical and of ironfoundry control.

So far as steel is concerned, we all know, or should know, that when a steel is stressed beyond its elastic limit neither the tensile nor anything else matters. In the case of a forging there may be an infinitesimal defect at the outsides of which the elastic limit is low or altogether absent, with the result that undue stress is thrown upon surrounding areas. There follows a fatigue crack which often mystifies everybody.

MR. POMEROY wrote in reply to Mr. Young that he was glad that Mr. Young supported the broad ideas set forth in his Paper. The practice he advocated of taking cast-iron test-bars out of the heads of the castings was one which should be encouraged, as otherwise a test-bar was only a record of the constitution of the material used and not always that. He assured Mr. Young that the conditions of the bearings in a marine engine were very different indeed from those in a high-speed internal-combustion engine, where one had to deal with P.V. factors ranging up to 25,000 and with oil-film temperatures which were high enough to cause local melting in the bearing.

Aluminium Pistons and Cylinder Wear.

MR. J. ARNOTT wrote that Mr. Pomeroy touched on one subject which was of interest both to the makers and users of cars, viz., cylinder wear. From observation and inquiry which the writer had made, cylinder wear in the cheap and medium-priced cars was to-day a serious matter. Five to ten years ago, *i.e.*, before the general adoption of aluminium pistons, re-grinding cylinders was rarely necessary before 50,000 or even 100,000 miles. To-day many cars, after a year's running, have the cylinders badly worn, and several makers and agents seemed to think it quite normal to re-grind after 15,000 to 25,000 miles.

The present arrangement of aluminium pistons necessitated large clearances, and in many models the oil consumption was high even when the car was new. The writer did not suggest that it was impossible or impracticable to make aluminium pistons and cast-iron cylinder blocks which would work satisfactorily for a long period, but he did submit that in the lower-priced cars, at any rate, much of the present production was unsatisfactory in this respect. There appeared to be a need for a noted improvement in the cast iron and aluminium, or, alternatively, for a reversion to light cast-iron pistons.

In answer to Mr. Arnott, MR. POMEROY wrote that his view was that the principal cause of cylinder wear was the fact that the use of aluminium pistons coincided with the use of low gear ratios, so that more power was developed by the engine at much higher engine speeds than were used with cast-iron pistons. As a result piston speed and piston wear had increased. Another contributory cause which was of great importance was that, with forced lubrication, the conditions of lubrication of the piston when an engine was being started were most unsatisfactory and need specially taking care of in the design of the engine. In the author's experience there was no reason at all why cylinder wear should be more than a thousandth of an inch per 20,000 miles, and by the use of suitable constant clearance pistons it could be made much less.

The Phosphide Eutectic in Cast Iron.—The results of experiments by M. Künkele are given in the Mitteilungen of the Kaiser-Wilhelm-Institut. A new etching process is described, which shows in grey cast iron a "binary" eutectic, consisting only of the solid solution and iron phosphide, with no cementite. Quenching and thermal tests showed that the "binary" eutectic really results from the crystallising out of the graphite of the cementite, the latter thus disappearing from the structure. The transformation point of this eutectic is about 960 deg. C., in so far as the displacement by variations in silicon is ignored. At this point, along with iron phosphide and solid solution, graphite separates out instead of the unstable cementite, the eutectic becoming stable. Alloys of iron, phosphorus and carbon can solidify in the meta-stable system iron—iron carbide—iron phosphide, or in the stable system iron—graphite—iron phosphide. In the first case the known ternary phosphide eutectic is formed on exceeding the solubility of carbon and phosphorus in iron. In the other case a ternary phosphide eutectic is formed, corresponding to that previously known as "binary," which is called pseudo-binary as the result of these experiments. The cementite eutectic can be formed in the solidification of grey iron if a change of system occurs by reason of which further solidification takes place in accordance with the meta-stable system.

Moulding a Rope Pulley.

By Arthur Greenhalgh.

Although the following method of making a rope pulley cannot be recommended as the quickest, it is a means by which one can be fairly sure of securing a well-balanced casting. It takes the moulder longer to make, but there is a saving in the fettling shop, the fettling required being reduced to a minimum. Though generally described as loam moulding, only the grooves are "slipped up" in loam, the arm and groove cores themselves being made of ordinary core sand. The top plate and bottom plate are also "loamed up" and these can be used repeatedly with a little patching up and reasonable care in handling them when getting the casting from the mould.

The bottom plate, which should have a hole in the centre for the spindle, and other holes here and there for vents, should be set level upon three stands, these being as low as possible for comfort in working. The spindle seating is set on the plate, the hub of the seating fitting in the hole in the centre of the plate; the seating is clamped to the plate or made secure by some other method. The spindle with the arm being in position, an ordinary straight-strickle board is fastened to the arm; upon the board, at a distance of the diameter of the pulley, is screwed a small strip of wood at an angle of about 45 degrees; this will form the down joint. The board will be set at a distance from the plate to allow for the placing of a layer of bricks, set in loam round the centre part of the plate, that is between the small strip of wood and the spindle. Between the bricks can be placed small ashes, which will help the drying as well as acting as a vent. The bricks are covered with loam to a depth of half-an-inch; this being strickled off level with the board forms the bed for the arm cores. The straight board is removed and a layer of loam is placed round the outside of the down joint, upon which is bedded the lifting plate for the grooves. The plate, after being tried on and parting sand put on the down joint, is finally bedded just below the bed for the arm cores. A, Fig. 1, illustrates the progress so far made. The board for setting and "slipping up" the grooves is now fastened upon the arm.

Making the Groove Cores.

The groove cores are made in one-groove segments about 14 in. long. They are rammed up in ordinary core sand, or a stiff loam (the latter being better) and dried in the stove. A thin layer of loam will be required upon the plate to bring the cores up to the required height to be set by the board. The process of building up, a groove at a time, is continued until the required number of grooves is reached. The back of the cores is filled in with bricks and loam in the process of building up.

Slip, that is loam made thin enough to run through an ordinary sieve, having been prepared, it is spread over the cores either by hand or by means of a brush. The board is worked round until the required smoothness is obtained, the loam being sprinkled with water when necessary to keep it soft and workable. The board can then be removed with care, so that none of the grooves is broken. The board is unscrewed from the arm and drawn gently towards the spindle. Loam stamps are placed at the bottom joint for the purpose of resetting, after which the grooves can be lifted away and placed in the stove or dried by other means. B, in Fig. 1, illustrates the stage before grooves are lifted away. Whilst the moulder has been working upon the mould a coremaker should have been ramming up the arm cores. For these, core sand should only be used for lining up that part of the core which comes into contact with the metal, the rest being floor sand and cinders. The cores are set upon the bed in a green state, and in setting them they should be tried with a gauge stick—both top and bottom—so that an assured thickness can be had the full depth of the rim. When they have all been set correctly, the joints on the rim and in the boss are made good; the vents are brought to the top—one vent peg connecting two cores.

The whole can now be finished and blackwashed. In blacking the arms, the blackwash should be made very thin, it being necessary to apply it by running or working a brush through the arm. If put on thickly it will leave streaks in the blacking, making the arms of the casting unsightly and rough. It is better when ramming up the arm cores to use a little specially-

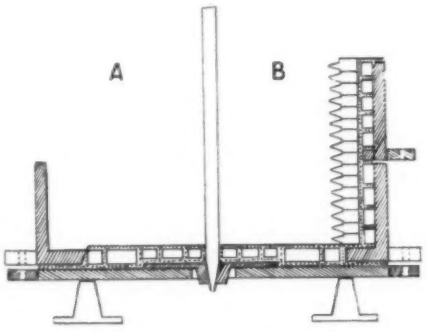


FIG. 1.—SUCCESSIVE STAGES IN MOULDING THE ROPE PULLEY.

prepared sand for using round the arms. This can be done by mixing the core sand and plumbago together, adding enough plumbago until the core sand is dry enough to pass through the ordinary foundry sieve. If this method is adopted and the arms then washed with thin blackwash, smooth arms in the casting will result. After blacking and finishing, the whole is placed in the stove to dry. Whilst this part of the mould is drying, the grooves can be dressed with sandpaper and blacked, and the top plate can be loamed up ready for drying. The top plate will have a centre hole, about 2 ft. in dia. and holes for vents and risers, which should come on the rim of the casting. The large hole in the

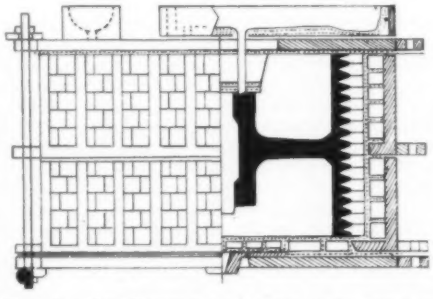


FIG. 2.—THE COMPLETED MOULD, ALSO SHOWING IN SECTION AN ARM CORE.

top plate is to allow the centre core to be placed in position after the top has been put on.

Closing the Mould.

The bottom plate with the arm cores is placed level, either on a bed or on low stands. The dust and dirt is swept away and the arms cleaned with a pair of bellows. In placing the outside part containing the grooves in position, great care will be required as the clearance for this is only $\frac{5}{8}$ in. to $\frac{3}{4}$ in.; the grooves must be prevented from catching the arm cores and having a portion broken off. With four men to keep it steady in the crane, the outside can safely be put in position and again set to the loam stamps at the joint. The first attempt should be, if possible, made successful, for there is always a risk in having to move it. The crane may go with a jerk or the men not control the movements so that damage results. Having been placed safely in position the bottom joint should be well stopped in with loam. The top plate can now be put on, ensuring that there is a nice touch on the arm cores and groove cores and also that the risers are directly on the rim. Having the top plate on will eliminate the risk of anything falling down the rim, as the riser holes should be plugged with waste until the riser is made up. The top joint can now be well stopped in with loam. There is not much likelihood of any damage being done in cleaning out the boss and inserting the centre core, which should be made of loam. It should be taken off the barrel and the centre filled with black sand, unless the barrel is short enough not to protrude above the top plate, in which case it would be in the way of making the runner. The boss is covered by a small loam cake with the runners through. A seating is provided in the body core for this loam cake, which, of course, also rests upon the centre core, keeping it in position. The covering cake can be kept down securely by placing packing upon it, away from the runners, then wedging it with a bar across the centre of the top plate, between the plate and the arm cores, by knocking away a little of the loam from the top plate, sufficient room will be made to allow for a bar. This having been fixed, the runner and risers are made up. The job is bolted together or weighted, and is then ready for casting, as shown in Fig. 2, which gives also a sectional view through the centre of one of the arm cores.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Structure of the British Foundry Industry.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The first letter in your correspondence columns of July 16 states that "there are no British sands that can be used without some adulteration or mixing of other sands for steel castings."

Your correspondent really should be sure of his ground before making assertions of this kind.

Natural moulding sand equal to the best Belgian steel-casting sands and which require no admixture has been quarried out of the quarries owned by this company, and supplied to the leading steel-casting firms in this country for more than 20 years, and is still being quarried.—Yours, etc.,

THE CORNISH SAND COMPANY,
Mansfield.

Standard Sand Quarries,
Mansfield, Notts.
July 28, 1931.

[This confirms what we said in our Paper to the American Foundrymen's Association. Actually our words were: "Loam, composition, dry sand and green sand are all used in the making of moulds, while there is a lively competition between Belgian and British sand as the principal basis. Synthetic sand—that is, a mixture of pure silica sand and clay—is not extensively employed."—EDITOR.]

When using a diamond truer on grinding wheels, plenty of coolant should be used to ensure cool running. The point of the diamond should be held so that it touches the wheel just below the centre line.

The Sand-Spun Pipe Foundry of the Staveley Coal and Iron Company, Limited.

The sand-spun pipe foundry, which has recently been started up by the Staveley Coal & Iron Company, Limited, of Chesterfield, is further evidence of the progressive policy which has at all times characterised the activities of the company.

Since 1840 the manufacture of cast-iron pipes has been one of the numerous specialities of the Staveley Company, and throughout the succeeding years the foundries have been kept well in line with the best up-to-date practice. Quality of the production has always been the first consideration. Innovations in plant and method, designed to reduce production costs, have only been considered when such reductions have not been obtained at the expense of quality.

Prior to starting up the new foundry, the Staveley Company were the second largest manufacturers of cast-iron pipes in the United Kingdom, the output from their vertically-cast pipe foundry being approximately 100,000 tons per annum.

The new pipe foundry is designed for an annual output of 80,000 tons per annum of pipes from 4 in. to 12 in. inclusive nominal diameters of 16 ft. laying length. The foundry has, however, been laid down so that it may be extended almost indefinitely without interfering with the present continuity. It is the intention of the management to extend the range of sizes produced, as necessity demands, to cover all commercial requirements.

Whilst it is not suggested that the vertically-cast pipe will be wholly superseded, at any rate by any known process of production, it is quite certain that its field will be narrowed very considerably by the introduction of the sand-spun cast pipe, which combines in a remarkable degree the generally recognised advantages of centrifugal casting with the virtues of the sand-moulded vertically-cast pipe.

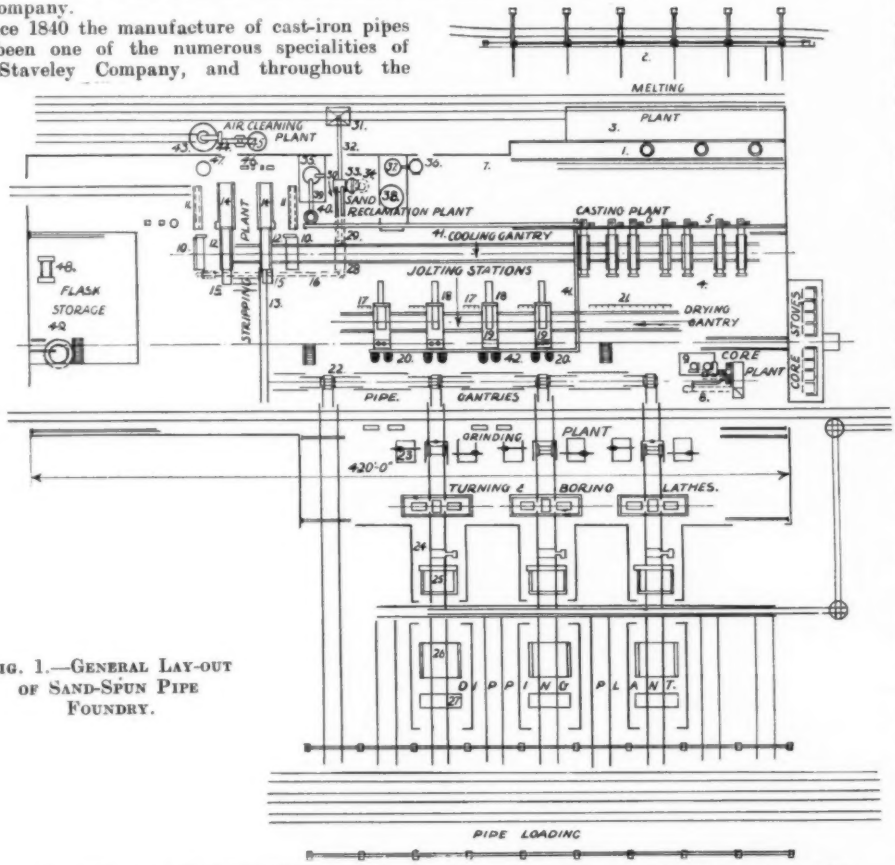


FIG. 1.—GENERAL LAY-OUT OF SAND-SPUN PIPE FOUNDRY.

1.—Cupolas. 2.—Bins for raw materials. 3.—Charging platform. 4.—Twisters. 5.—Tilting ladle. 6.—Weighing machines. 7.—Ladle lining and drying. 8.—Core-sand drier. 9.—Socket core jolters. 10.—Blow box. 11.—Blow-pipe carriage. 12.—Stripper tilting table. 13.—Pipe transfer carriage. 14.—Double-acting rams. 15.—Sand-collecting hopper. 16.—Shaker conveyer. 17.—Air-cooling jets. 18.—Tilting tables. 19.—Jolters. 20.—Sand feeders. 21.—Mould drying burners. 22.—Turntables. 23.—Grinders. 24.—Pipe weighing. 25.—Proving. 26.—Pipe stoves. 27.—Dipping tanks. 28.—Sand-cooling drum. 29.—Chain elevators. 30.—Sand-storage bunker. 31.—Rejections bunker. 32.—Belt conveyers. 33.—Smith sand mixer. 34.—Sand feeder. 35.—Simpson sand mixer. 36.—Clay mill. 37.—Clay mixer. 38.—Clay-wash storage. 39.—Belt elevator. 40.—Sand feeder. 41.—Belt conveyors. 42.—Tripper conveyer. 43.—Cyclone separator. 44.—Fan. 45.—Air scrubber. 46.—Sludge pumps. 47.—Sludge separator. 48.—Flask balancing. 49.—Accumulator.

During the past few years considerable progress in the methods of manufacturing cast-iron pipes has been made; changes, indeed, in process which may well be called revolutionary, and it was no doubt a consideration of possible developments in the early future which determined the management of the Staveley Company to make a careful study of the various processes, and in the meantime suspend further capital outlay upon the existing foundries.

As the outcome of lengthy experiment and personal investigation of the sand-spun process of manufacture in the United States and Canada, it was determined to adopt this process at Staveley, to which end were acquired the sole patent rights for Great Britain from the Sand Spun Corporation.

With the system referred to, the pipes are produced by centrifugal casting in sand moulds rammed in cast-iron flasks, which are revolved at a speed, imparting to the metal forming the pipe, a centrifugal force of approximately seventy times that of gravitation.

Obviously, pipes so formed possess all the advantages which pertain to the centrifugal process, but, further, with this process there is no possibility of the pipes being chilled, as solidification and ultimate cooling of the pipe is exclusively from the periphery, which is in contact with the sand, and as the pipes are cooled gradually and are not removed from the moulds whilst showing any colour of heat, no subsequent annealing is required. It will thus be seen that the good qualities of the old sand-cast pipes—flexibility, ease of machining, drilling, tapping, etc.—are retained without any sacrifice of the advantages of centrifugal casting, the most important of which are the freedom from shrinkage, cavities, blow-holes and inclusions of any kind.

It will be readily understood that perfect balance of the rotating mould and flask is imperative; it follows, therefore, that strict concentricity of the mould in the flask must be maintained; this, of course, ensures the pipes being truly concentric and of uniform section both circumferentially and longitudinally.

Owing to the greater density of the iron due to the centrifugal action, the thickness of the walls of the pipes can be at least 25 per cent. less than that of the vertically-cast (or pit-cast) pipe for the same strength. Compared with vertically-cast pipes of equal nominal size and class the sand-spun pipes show 40 per cent. greater resistance to hydrostatic pressure, 20 per cent. greater values in cross bending and 25 per cent. greater resistance to shock.

The reduction in the necessary thickness of the walls affords a free internal diameter at least 5 per cent. greater than that of the vertically-

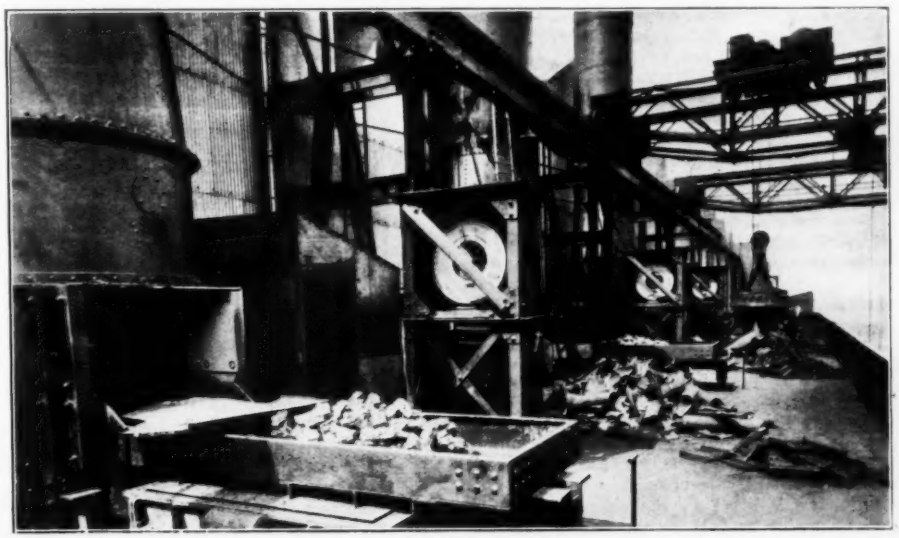


FIG. 2.—CUPOLA-CHARGING PLATFORM.

cast pipe of similar external diameter. The sockets, being made to British Standard Specification dimensions, permit the sand-spun pipes being used with existing cast-iron pipes and also with British Standard Specials, and further, allows pipes to be made having turned and bored joints.

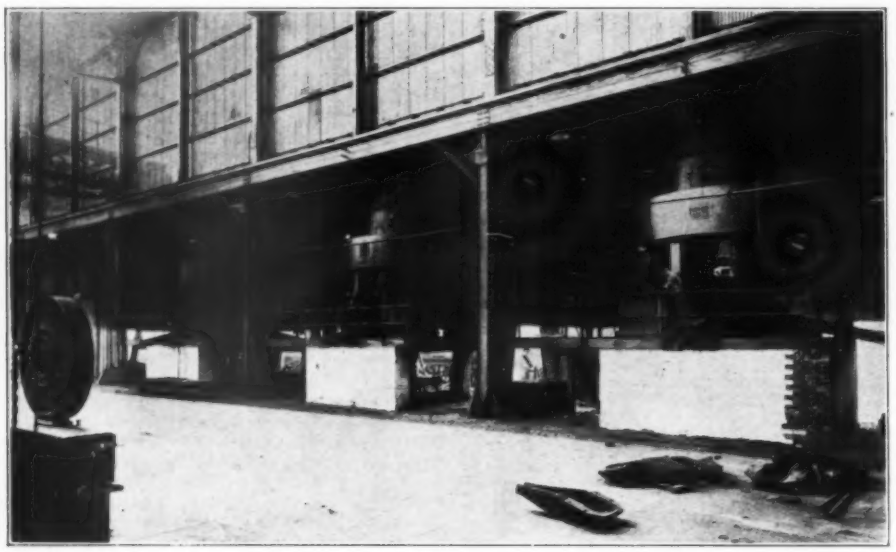


FIG. 3.—CUPOLA-WORKING PLATFORM.

As previously stated, the sand-spun pipes are made in lengths of 16 ft., which, in combination with their lightness means an increase of approximately 33 per cent. in length of main for the same tonnage and also a saving of 25 per cent. in joints, with a corresponding saving in labour and jointing material. Over a length of main the factors set out above will certainly prove a convincing argument in favour of the sand-spun pipe.

The Sand-Spun Pipe Foundry.

The sand-spun pipe foundry forms an entirely self-contained and independent works, situated at Hollingwood, near Chesterfield, on a site adjacent to the Devonshire works and to the vertical-pipe foundry, the works lying between the lines of the L.M.S. and L.N.E. Railways.

The works were designed and laid out by the engineering staff of the Staveley Company and under their supervision, erected and equipped by Markham & Company, Limited, Chesterfield.

In the lay-out full advantage was taken of railway facilities both for the handling of the raw materials and the despatch of the finished product, whilst very ample provision was made for carrying stocks of pipes. At the same time the general scheme is such that future extensions can be carried out and the present continuity of operations be maintained.

The general arrangement of the plant is shown in Fig. 1, from which it will be seen most of the equipment is housed in one main building and three secondary ones adjacent thereto. The buildings are steel-framed and covered with asbestos corrugated sheeting; they are roomy, lofty, well ventilated and well lighted, in fact, thoroughly representative of all that is best in a modern works.

Facilities for Handling Raw Materials.

The stocking bins for the raw materials are situated between two lines of railway track, a low-level track between the bins and the melting plant and a high-level track on the far side of the bins. The normal practice is to deliver pig-iron, etc., on the low-level track, when the trucks are diacharged direct to the charging platform for the cupolas or into stock, as the case may be, by one of the two overhead Craven cranes of 5 tons capacity, which are fitted with Allen West lifting magnets, 55 in. dia. and of 3,000 lbs. lifting capacity.

Coke is delivered on the high-level line and discharged through side doors direct into the storage bins. There is thus very ample provision for the storage and handling of raw materials. Further, the cupola-charging platform is constructed for a carrying capacity of 5 cwts. per sq. ft., and so made suitable for accommodating ample stocks of iron and coke for regulation of the charges.

Melting Plant.

The melting plant comprises three modern cupolas, each of 12 to 15 tons per hr. capacity. The cupolas are fitted with five main and five auxiliary tuyeres, all provided with their own individual dampers. They are of the drop-bottom type, the drop falling on to a drag which is skidded from beneath the cupola by a crane operating through a block. The cupolas are charged by pneumatically-operated tilting trays, the charge being weighed on a Pooley weighing machine of the dial type.

The blowing plant comprises two Keith-Blackman motor-driven fans, which are installed side by side on the charging platform. Each of these fans is equal to a duty of 6,000 cub. ft. of free air per min. at 36-in. w.g., when running at 1,740 r.p.m.

The slagging spout discharges into self-emptying and righting cast-iron slag pots, which are mounted on ball-bearing bogies, and deliver into steel tipping wagons for transit to the dump. The cupolas are operated in turn over periods of 24 hrs., the plant being continuous. In practice, one cupola is blowing, the second standing by ready to take over, whilst necessary repairs are being carried out on the third. A small pig bed is provided at tapping level, which is used for the discharge of surplus iron.

The Casting Machines.

If we now describe the casting machines it will simplify our treating subsequently with a complete cycle of operations in the production of a sand-spun pipe.

There are seven casting machines, or twisters, as they are more commonly called. Each twister is capable of producing from 60 to 72 diametral in. per hr., irrespective of the size of pipe made for the time being. The twisters are arranged in couples, each couple being devoted to the manufacture of a certain size of pipe.

Only minor adjustments are required when altering the size of pipe to be manufactured, and the seventh twister is installed as much to facilitate such adjustments being made without interference with the operations of the plant so as to act as a standby to the other units.

Briefly described, a twister consists of a strong steel frame carrying two idler and two driving rollers which revolve between self-aligning Skefko bearings. Brakes and driving pulleys are carried on extensions of the roller shafts. The twister frame is bolted down to a reinforced-concrete foundation in which is also accommodated the hydraulic gear for operating the flask-exchanging device, simultaneously with the lifting of the hood which normally protects the machine operators against the possible projection of sand or metal particles.

Each twister is driven through belts by two slip-ring motors which are located in the cellar; they are each capable of developing from 12½ to 15 h.p. at 860 r.p.m., with 30 cycles, 440 volts a.c. Specially-designed contactor gear with remote control is used for the simultaneous starting and stopping gear of each pair of motors. This form of drive has been adopted because, obviously, mechanical slip would not be permissible, but the slip due to wear, which is inevitable, is provided for electrically.

The brakes are Ferodo-lined and are of the hand-operated weighted type. Each twister is provided with a tilting ladle; the carriage carrying this ladle is mounted on rails and normally

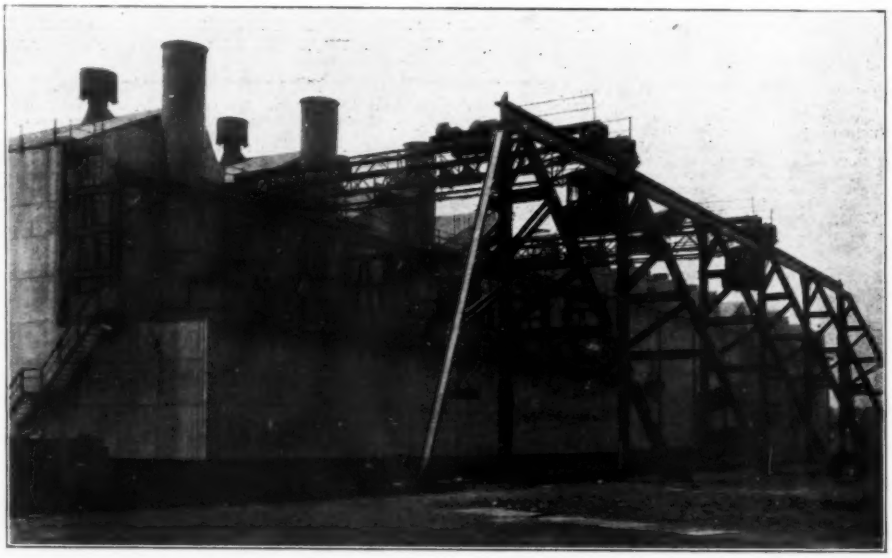


FIG. 4.—CUPOLA-CHARGING CRANES AND GANTRY.

rests on the platform of a Pooley dial weighbridge.

We will now follow the cycle of operations from the cupola on the one hand and the moulding machines on the other. The flasks containing the sand moulds are deposited in pairs on both sides of each couple of twisters by a 10-ton Craven crane which is equipped with a special flask-engaging gear guided in a semi-rigid frame

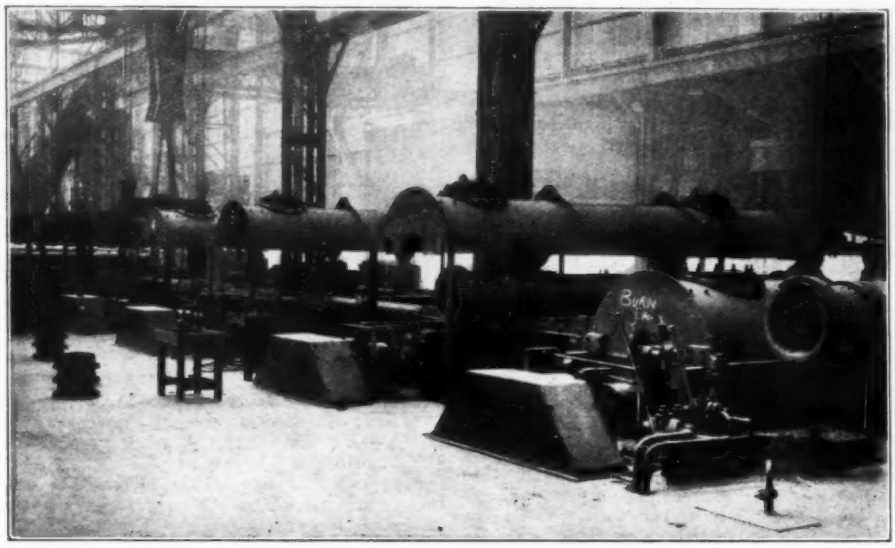


FIG. 5.—VIEW OF CASTING MACHINES OR TWISTERS.

suspended from the crab. The flask-handling gear consists essentially of four steel fingers, two of which are pivoted at the lower end of each branch of a U-shaped frame. These fingers are normally held in the vertical position by triggers, but are released by the triggers coming in contact with the flask and allowed to fall to an angle of about 45 deg. beneath the flasks to be lifted. At the points of discharge for the crane on the various gantries the lifting device engages with a girder and roller-path by which the carrying fingers are restored to the vertical and held in position by the triggers previously referred to. It will be readily understood the ease and speed with which flasks can be transported from one gantry to another by this arrangement.

The hydraulic gear previously referred to automatically discharges the mould previously cast and feeds in the empty mould, raising the protecting hood at the commencement and lowering it at the completion of the cycle. Metal is tapped from the cupolas into two bull ladles of 3½ tons capacity each. These ladles are carried upon a transfer carriage mounted on ball bearings; seating is provided for two ladles, so that the one is being filled whilst the second is discharging into the ladles feeding the casting machines.

From the transfer carriage the ladles are picked up by a 7½-ton Craven crane which is provided with a control cabin near floor level so that the crane driver is himself able to distribute the molten metal to the tilting ladles of the twisters. The weight of the metal to form the pipe of the dimensions being cast having been teemed, the carriage carrying the ladle is moved forward a matter of about 2 ft. by hand, which brings it into position for engagement by the hydraulic ram, which passes through the centre of the weigh platform and engages with a roller at the rear of the tilting ladle. As soon as this position is reached, it makes electric contact to notify the operator of the twister that the ladle is in the tipping position. It should be noted that immediately after transferring the iron to the tilting ladle, a very small quantity of soda is placed on the molten metal, which, with any particles of dust which become detached from the mould, forms a fusible slag easily removed by a scrubbing apparatus after cooling. All operations in connection with the twister, it may be noted, are controlled by the operator at the end distant from the casting point. The machine is now started up, and as soon as it has reached the normal speed, which is indicated by a pilot lamp, the hydraulic ram is put into operation, and the metal, at a temperature of about 1,350 deg. C., is tipped into the mould. The pouring time occupies 1 sec. for each diametrical inch. The centrifugal force is maintained upon the walls of the pipe until the whole of the pipe is solidified by the rotation of the mould. After solidification the power is cut off, when the twister slows down and is finally brought to rest by the brake.

The flask containing the cast pipe is discharged on to the cooling gantry, which has a length of 160 ft., along which the flasks are slowly rolled to the stripping plant, which they reach in approximately an hour from the time of casting; the pipes are then dark and the moulds thoroughly dried.

(To be concluded.)

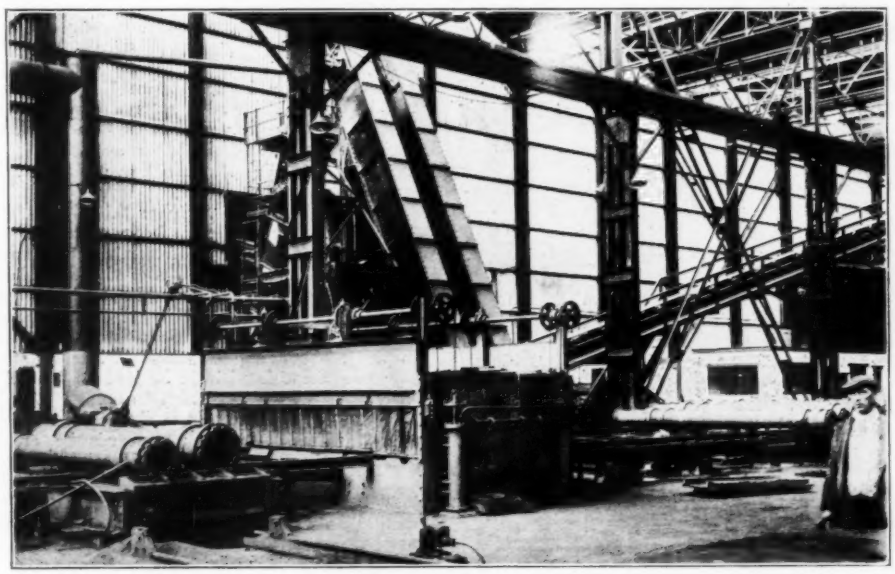


FIG. 6.—PORTION OF STRIPPING PLANT.

National Physical Laboratory.

The annual inspection by the General Board took place recently when visitors were received by Sir Gowland Hopkins (President of the Royal Society, chairman of the Board), Sir Richard Glazebrook, K.C.B., F.R.S. (chairman of the Executive Committee), and the director. Many of the exhibits had not been shown at previous inspections. These included hardness tests on bearing metals at temperatures up to 350 deg. Fah.; minimum permissible sizes of test-pieces for Brinell hardness tests; "Cupping" tests for determining or indicating the drawing properties of sheet metal; special plant for measuring "creep" rates of one-hundred-millionth of an inch per hour, regarding which it was pointed out that considerable research work is now being directed towards the study of the mechanical properties of metals at high temperatures. It is now known that metals are liable to stretch continuously or "creep" at high temperatures under the influence of prolonged stresses, which may be much lower than the quick-breaking stresses at those temperatures. For example, a stress of 5 tons per sq. in. causes a mild steel to creep continuously and to fail eventually at a temperature of 500 deg. C., although a stress of 20 tons per sq. in. is needed to produce failure in a few minutes at 500 deg. C.

Developments are taking place in the use of higher pressures and temperatures in boilers, superheaters, turbines, chemical plant, etc., and, since the rate of creep of metals under constant stress increases rapidly with the temperature, either much thicker sections of metal must be used or improved metals must be found which offer greater resistance to creep at high temperatures.

A new creep-testing plant has been designed and constructed which is much more accurate than any previously available. It measures creep rates of the order of one-hundred-millionth of an inch per hour. In the same machine the elastic properties of specimens can be examined with great precision either before creep or at any stage during creep. Preliminary experiments show that specimens under examination can be maintained within half a degree centigrade of the required temperature for long periods by means of a specially-designed temperature control.

Other interesting demonstrations related to the cracking of boiler plate and metals for use at high temperatures.

Influence of the Temperature of the Ingot Moulds on Position of Blowholes.

The distribution of blow-holes in an ingot is, above all, determined by the manner in which it solidifies. This depends to a great extent on the rate at which heat is lost, affected by a number of factors such as the casting temperature, duration of pouring, shape and temperature of the mould, and the condition of the surrounding atmosphere. Of these the temperature of the mould is most readily altered, since the others are largely fixed and can be only slightly modified without introducing other casting defects. An investigation on the effect of variations of the mould temperature on the occurrence and location of blow-holes near the surface of ingots was recently carried out by DR.-ING. AUGUST STADELER and DIPL.-ING. H. J. THIELE. The description of these tests with the results obtained is contained in a report of the Steelworks Committee of the Association of German Ironmasters, published in "Stahl und Eisen."

Two sizes of ingots were investigated, weighing respectively about 0.2 and 3.5 metric tons, both of the flat type. The section of the larger size was a flat oval about 1,020 mm. (40 in.) by 450 mm. (17½ in.) at the bottom and 980 mm. (38½ in.) by 450 mm. at the top. The height of the mould was 1,600 mm. (about 63 in.). The mould weighed 5.69 metric tons. Mild steel of boiler-plate quality was used, the analysis of which, in the case of the heavier ingots, was C = 0.095 to 0.15, Mn = 0.39 to 0.69, P = 0.013 to 0.026, S = 0.024 to 0.038 per cent., giving an ultimate tensile strength of 35 to 44 kg. per sq. mm. (22.2 to 27.9 tons per sq. in.) with a minimum elongation of 25 per cent. The ingots were bottom-poured. In each case two ingots were poured from the same heat, arranged symmetrically on the casting plate, one cast in a mould at room temperature and the other in a mould at the temperature under investigation. This was necessary since the position of the blow-holes with cold moulds was found to vary between different heats, the distance from the surface to the blow-holes being therefore expressed as a percentage of that in the ingot cast in the cold mould, for each pair of ingots.

The investigation showed that the position of the blow-holes, which only occurred in the rim of the heavy ingots (distances of 14 to 35 mm. (½ in. to 1⅜ in.) from the surface) was affected by the temperature of the mould. The most favourable position of the blow-holes, *i.e.*, the farthest from the ingot surface, was given by an initial temperature of 60 deg. C., or from about 500 deg. C. upwards. Between these temperatures the blow-holes were nearer the surface. Since it is impracticable to cast in moulds at 500 deg. C. or higher, the best possible initial temperature is therefore 60 deg. C. This agrees with the old "golden rule" of the steelworks, according to which the moulds before pouring should be warm to the touch.

No blow-holes appeared in the rim of the small ingots under normal conditions of pouring, namely, with the metal rising in the mould at the rate of about 14 to 18 cm. (5½ in. to 7 in.) per min. The main reasons for this are the low pressure of the liquid steel and the early rise of the absorption pressure of the occluded gases. The same reasons apply to the freedom from rim blow-holes in the upper portion of the large ingots. The difference in the thickness of the rim zone, and consequently in the distance of the rim blow-holes from the surface of the large ingots, is explained by the variations in the flow of heat from the ingot to the mould at the different temperatures of the latter. The caterpillar-like appearance of the inner surface of the blow-holes is due to the pushing forward of the gas blow-holes in jerks into the still liquid core of the ingot, at each forward movement an ellipsoidal hole joining on to the preceding one.

Metallographical examination brought to light segregations in the small ingots, and to a lesser extent in the upper portion of the large ingots which was free from blow-holes, near the rim, which occupied a position corresponding to that of the absent blow-holes. The occurrence of these segregate channels can be regarded as due to the increase in liquid pressure and gas solubility after the outer layer has solidified. The reabsorption of the gases causes the already-formed blow-holes to fill up with the mother liquor of the interior of the ingot, which is high in sulphur and phosphorus.

Chemical and metallographical examination did not permit drawing definite conclusions regarding the influence of cold and preheated moulds on segregation in flat ingots.

The Ternary System Iron-Sulphur-Carbon.

A recent issue of the "Archiv für das Eisenhüttenwesen" contains a report of an investigation of the equilibrium diagram of the iron-sulphur-carbon system by R. Vogel and G. Ritzau. The alloys were prepared by melting pure soft iron with carbon, pure crystallised sulphur being added to the resultant melt in different proportions up to 33 per cent. It was not found possible to introduce carbon into melts of iron and sulphur. It was shown, however, how miscibility gaps in the liquid state in ternary systems could be determined from the temperature-concentration-sections. A method was given by which one branch of the miscibility gap could be determined when the other was known, which had the advantage that it was only necessary to examine an easily tested portion of the section.

The still little-investigated relationships of a ternary diagram with miscibility gaps in the liquid state, of the type of the iron-sulphur-carbon system, were elucidated. It was specially shown that besides the zone of primary dissociation, already present before commencement of crystallisation, it is necessary to differentiate a second contiguous concentration zone of secondary or even tertiary dissociation, where the formation of little drops first occurs after partial solidification, and in which further the dissociation can be reversed. The theory shows that iron sulphide can occur in the form of drops at very low contents of carbon and sulphur, which lie far below the concentrations of the primary stratification.

The complete ternary equilibrium diagram for iron- iron sulphide- iron carbide was determined on the basis of five different sections. Only three types of crystals separate out, namely, binary mixed crystals of iron with carbon, cementite and iron sulphide. The boundary curve of the primary dissociation and the area of the secondary dissociation were determined.

The temperature of the equilibrium of the four phases $F_1 - F_2 + \gamma_F + Fe_3C$ is 1,100 deg. C., the composition of the liquid phases being 4 per cent. C and 0.8 per cent. S (F_1), as well as 29.5 per cent. S and 0.25 per cent. C (F_2). The co-ordinates of the ternary eutectic point are: 975 deg. C., 0.15 per cent. C and 31 per cent. S.

The quantity of cementite in the ternary eutectic is almost nil; this consists mainly of iron sulphide and a binary mixed crystal of iron with carbon. The decomposition of the mixed crystals with separation of ferrite and cementite is not appreciably affected by the sulphur content of the iron-carbon alloy, nor is the temperature of the pearlite point.

Iron and Steel Institute.

As already announced, arrangements have been made for holding the autumn meeting of the Institute this year at Swansea. Mr. Lewis Jones, secretary of the South Wales Siemens Steel Association, is the hon. secretary of the local reception committee and is also acting as the local hon. secretary of the meeting. His address is: Royal Metal Exchange, Swansea. The following is a programme of the meeting:—

TUESDAY, September 29.

10 a.m.—General meeting in the rooms of the Royal Metal Exchange. Welcome by the Mayor of Swansea and by the chairmen of the Siemens Steel Association and the Welsh Plate and Steel Manufacturers' Association. A selection of Papers will be read and discussed.

1 p.m.—Members and their ladies will be entertained to luncheon at the Drill Hall, Swansea, by invitation of the British (Guest Keen Baldwins) Iron & Steel Company, Limited.

2.30 to 6 p.m.—Visit to the Port Talbot and Margam Works of the British (Guest Keen Baldwins) Iron & Steel Company, Limited.

8.30 p.m.—Reception and dance by the Mayor of Swansea (Councillor J. Miller, J.P.), at the Drill Hall.

WEDNESDAY, September 30.

10 a.m.—General meeting in the rooms of the Royal Metal Exchange. A selection of Papers will be read and discussed.

1 p.m.—Members and their ladies will be entertained to luncheon at the Drill Hall by Messrs. Baldwins, Limited.

2.30 to 6 p.m.—Visit to the King's Dock Tinplate Works (Messrs. Baldwins, Limited), Swansea, or, alternatively, to the Grovesend Steel & Tinplate Company, Limited, at Gorseinon.

7.30 p.m.—Banquet at the Drill Hall by invitation of the Siemens Steel Association and the Welsh Tinplate Manufacturers' Association.

THURSDAY, October 1.

10 a.m.—General meeting in the rooms of the Royal Metal Exchange. A selection of Papers will be read and discussed.

1 p.m.—Members and their ladies will be entertained to luncheon at the Drill Hall by the Anglo-Persian Oil Company, Limited, and the National Smelting Company, Limited.

2.30 to 6 p.m.—Visit to the National Oil Refineries of the Anglo-Persian Oil Company, Limited, at Llandarcy, or, alternatively, to the Swansea Vale Spelter Works of the National Smelting Company, Limited, Swansea.

8.15 p.m.—A Welsh musical evening will be arranged.

FRIDAY, October 2.

8.50 a.m.—A train will leave Swansea for Newport, by which a party of members can travel to visit the Courtybella Works of the Whitehead Iron & Steel Company, Limited (12-in. Morgan continuous hoop and tube strip mill, and the new 12-in. to 14-in. Morgan semi-continuous bar and strip mill, completed in 1931). The number taking part in this visit is limited to 50. The management of the works will arrange for the conveyance of the party from the station to the works. The visitors will afterwards be entertained to lunch at the Westgate Hotel, and those proceeding in the direction of London can take the 3.30 p.m. train from Newport. Members returning to Swansea can take the 4.14 train from Newport, arriving at Swansea at 5.55.

For the visitors remaining in Swansea over Friday, October 2, a motor tour will be arranged over the Brecon Beacons into Mid Wales, returning through the Towy Valley to Carmarthen and back to Swansea. Particulars of the charge for this excursion will be communicated later, but it is not expected to exceed 20s.

PROGRAMME FOR LADIES.—The Local Reception Committee will make alternative arrangements for the entertainment of ladies during the afternoons of the meeting days, Tuesday, Wednesday and Thursday.

A New Type of Testing Machine.

INTERESTING FOUNDRY APPLICATIONS.

Of special interest to the foundry industry is the recently-developed Tensometer, a small portable combination tensile- and Brinell-testing machine weighing but 20 lbs. Whilst attempts have previously been made to evaluate the strength of a casting by trepanning small test-pieces from various sections of a casting and testing them by transverse or shear, British expert opinion has not regarded the results obtained as satisfactory. Inter-relationship with other tests has not been well established, but in the case of the Tensometer, reasonable agreement —2 per cent —with full-sized test-pieces has been proved by trials carried out at the National Physical Laboratory.

Naturally, when using the machine, intelligent appreciation of the effect of the absence of "casting skin" must be given. The diameter of the test-pieces is only 0.16 in., which, obviously, admits of the testing of quite small sections of commercial castings, whilst in many cases they can be cut from the body of an article without damaging it. Despite the smallness of the test-piece, the machine can be used with every confidence for either routine or serious technical work. Especially will it be useful for testing defective parts, of too small dimensions for ordinary tensile testing. The preparation of the test-pieces and the ascertaining of the results are greatly facilitated by the inclusion in the equipment of several gauges. Initially, the prepared test-piece, measuring between the shoulders 0.6275 in. and 0.1593 in. dia., is placed into an elongation gauge, which resembles a core box, the top half of which is provided internally with two points for establishing the gauge length. Externally there is a projecting ball, which, on being tapped with a hammer, causes the points to print the test-piece. The general construction of the machine is shown in Figs. 1-3, whilst Fig. 3 shows the insertion of the specimen into chucks of the machine. The apparatus, being provided with universally-mounted chucks, will make a special appeal to the founder of grey iron. The load is applied by a screw and lever mechanism to the

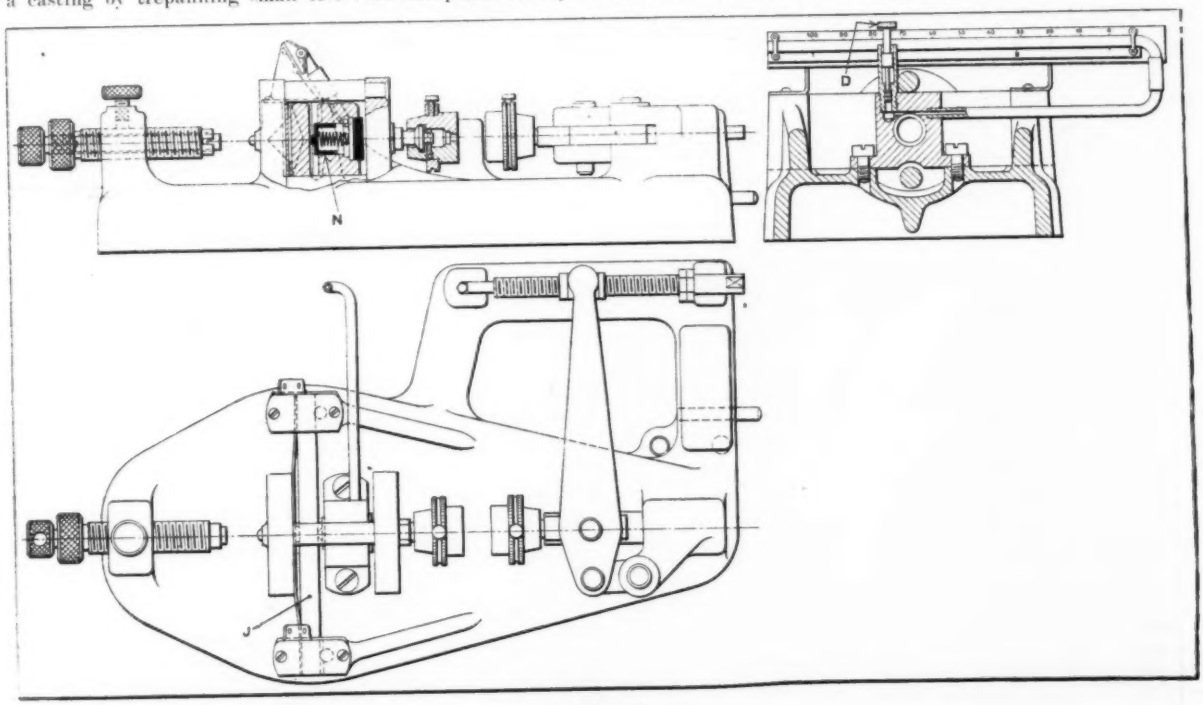


FIG. 1.

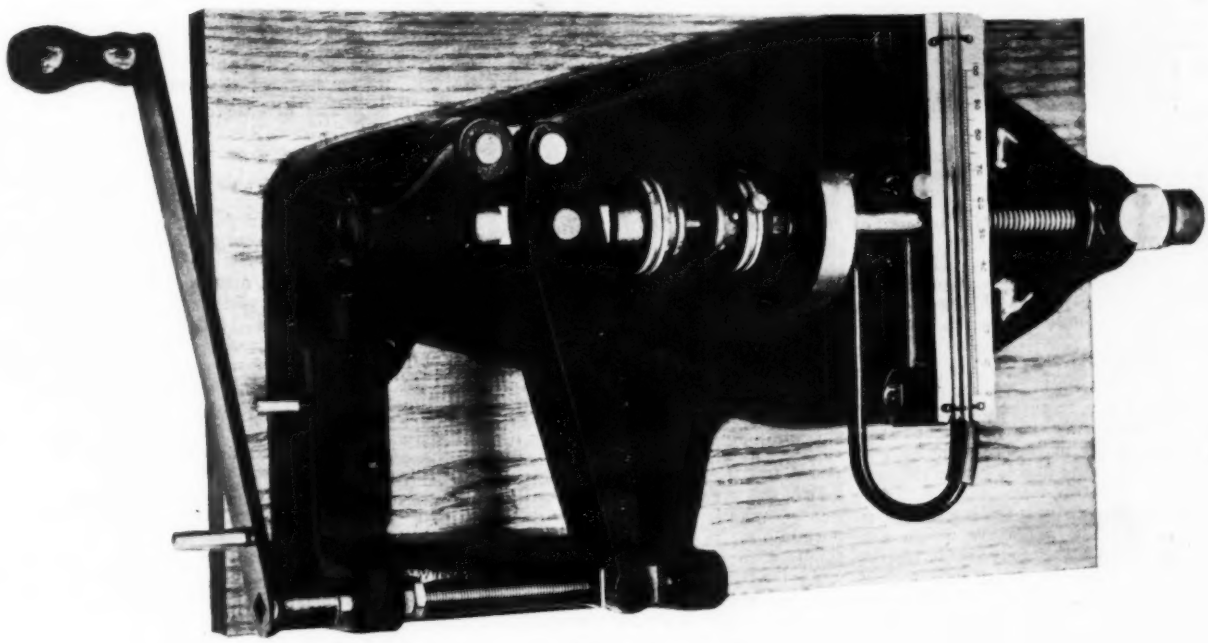


FIG. 2.

tail piece, as shown in Fig. 1. The deflection of the beam is measured by the displacement of a piston in the small mercury cylinder shown in Figs. 2 and 3, the arrangement permitting of the reading of both tons per sq. in. and the actual load on the specimen. The rotation of the handle is quite an easy matter for effecting fracture, whilst the examination of the dimensions of the broken test-piece is facilitated by the provision of gauges giving direct readings.

The machine, which we tested in our own office, was provided with an autographic recorder. This inexpensive attachment permits of the creation of a stress-strain diagram, by co-ordinating tons per sq. in. with the number of turns of the handle. Arrangements have been provided for readily striking a zero point with a needle on a squared chart mounted on a roller. After each turn of the handle a needle impression is made on the chart, and the yield point and maximum stress are very clearly traced. A feature of the machine is the ingenious way everything has been arranged to effect compactness.

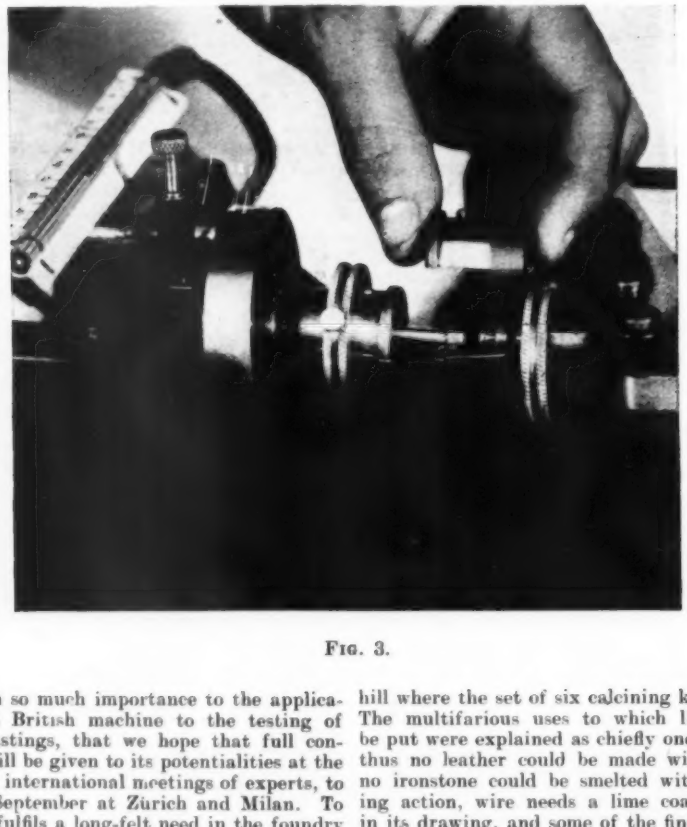


FIG. 3.

We attach so much importance to the application of this British machine to the testing of grey-iron castings, that we hope that full consideration will be given to its potentialities at the forthcoming international meetings of experts, to be held in September at Zürich and Milan. To our mind, it fulfils a long-felt need in the foundry industry. We recognise that it cannot interpret the strength of a casting; we realise that the core of large sections will be weaker than the periphery, and that the removal of the skin of casting affects the tensile strength; but the constant and general use of the Tensometer will provide knowledge enabling one to gauge the real strength of cast-iron castings.

The inclusion of a hardness-testing machine giving Brinell numerals is a feature which will be much appreciated by the foundry industry. The load is fixed at 1,500 kilograms and a permanent scale is provided for the direct reading of Brinell hardness numbers, after taking the diameter of the impression with a handy microscope. The machine is manufactured by Tensometer, Limited, 73, Southampton Row, London, W.C.1.

For heavy foundations four parts of washed broken brick, one part of clean, sharp sand and one part of Portland cement is a good mixture.

Foundry Technicians Visit Limestone Quarries.

The annual picnic of the Lancashire section of the Institute of British Foundrymen was held recently in the form of a motor-coach excursion to Buxton. The party of over sixty left Manchester soon after one o'clock, and travelled by the Goyt valley route to their objective. By the courtesy of the Clay Cross Company, of Chesterfield and Buxton, the party first visited the Grin Quarries on the hill-top above the latter town, and were conducted over the plant by Captain Barker. Visiting first the open-cast quarry, it was explained that the face was over one and a-quarter miles long, with a total depth from the crest of the hill of two hundred and fifty feet. This is worked in four steps, blasting operations being required to remove slabs of about two thousand tons at a time, which is then broken up into small enough fragments for transport by light railway to the top of the hill where the set of six calcining kilns is placed. The multifarious uses to which limestone may be put were explained as chiefly one of cleansing, thus no leather could be made without its aid, no ironstone could be smelted without its fluxing action, wire needs a lime coating to assist in its drawing, and some of the finest stone finds its way to France for the manufacture of face powder. Although the deposit now stands at the top of a hill, it had been laid down as a deposit at the bottom of an inland sea, and the dry nature of the quarry floor was explained as being due to its draining into Poole's Cavern many feet below. Six large kilns are used for firing the stone into quicklime, and the hoisting arrangements are by inclined plane, as in normal blast furnaces. After trommelling out the smalls with the coal ashes the lumps are sorted and stored. The powerful action of water on the lime was demonstrated by Captain Barker, the hard stone breaking up with the evolution of much heat and a considerable amount of steam. The fines from the kilns are treated in an automatic hydrating machine and ground in a screw conveyor for the purpose of packing as whitening.

The party afterwards proceeded to the Palace Hotel in Buxton where tea was served, and the thanks of the members was suitably expressed for the courtesy and hospitality of the Clay Cross Company, by Mr. Roy W. Stubbs, the district chairman. Following upon the very successful visit to the company's works in Chesterfield last year he expressed the hope that they would have another works available for a visit next year. Mr. D. Rushworth and Captain Barker acknowledged the expression of thanks, and regretted that they had not been able to arrange for a cinematographic record to be taken of the visit as was the case last year. Interesting country was visited on the homeward route which passed through Bakewell and Rowsley, going past Haddon Hall, and through the famous Chatsworth Park where the deer were visible. Thence the route lay through Baslow, Colver, Tideswell and Peak Forest, thus including the most picturesque parts of moorland Derbyshire. The value and pleasure of the outing was much enhanced by the splendid sunny weather which was experienced during the whole of the trip.

International Foundry Exhibition and Congress.

MILAN, SEPTEMBER, 1931.

The preparatory work for the big international event, which will take place in Milan in September next, is nearing its end, and we are glad to announce that the organisers are more than satisfied with the results of their endeavours.

The largest makers of foundry machinery in America and Europe will take part in the Exhibition, and in the stands of A. G. George Fischer, of Schaffhausen; Badische Maschinenfabrik, of Durlach; Gustav Zimmermann, of Düsseldorf; Bonvillain & Ronceray, of Choisy-le-Roi; Osborn Manufacturing Company, Limited, of Cleveland, Tabor, etc., there will be displayed the best and most highly-perfected moulding machinery.

There will be also plants for the preparation of sands by Fischer, Badische Maschinenfabrik, Stotz, Baillot, Peter Hammers.

The Polak Company will exhibit machines for making castings under pressure; Brown-Boveri their electrical furnaces, and there will be exhibited also pulverised-fuel melting furnaces, as for instance the Brackelsberg.

The artistic and ornamental castings section has been the object of particular care, and will assume an important position in the Exhibition, as the Committee has already been assured of the participation of the best known artistic foundries.

The Educational section, too, will certainly rouse the interest of laymen as well as of technicians; as a matter of fact, in this section the "Ecole Supérieure," of Paris, several German Schools, in addition to the most important Italian Schools, will participate with copious and interesting material. A considerable group of French and British firms will also take part in the Exhibition.

As regards the Congress, about 42 Papers, of which 20 are from abroad, have been sent up to date. They are all original, and are presented by persons distinguished in science and technology, and will be a valuable contribution towards making recent advances in foundry practice a matter of common knowledge.

The interest roused in the Congress is quite exceptional, and in addition to the several institutes and technical associations, the "Nouvelle Association Internationale pour l'Essai des Matériaux," the "Commission Internationale des nouvelles méthodes d'Essai des Fontes," and the American Foundrymen's Association have announced that a considerable number of their members will attend the Congress.

Registrations of members of the Congress and the sending of the programme have already been begun.

Trade Talk.

MESSRS. RUSTON BUCYRUS, LIMITED, Lincoln, have secured a contract valued at between £90,000 and £100,000 from Soviet Russia for 22 excavators, including Diesel, steam, and electrically-driven appliances.

SHIPMENTS OF IRON ORE from the Wabana iron-ore mines of the Dominion Steel & Coal Corporation have been completed for the season. Contracts for the delivery of iron ore up to the end of April amounted to about 635,000 tons.

MESSRS. DORMAN, LONG & COMPANY, LIMITED, have secured the contract for some 15,000 tons of steelwork for the buildings of the Pretoria works which are being laid down by the South African Steel & Iron Industrial Corporation.

MESSRS. CROFTS (ENGINEERS), LIMITED, Thornbury, Bradford, have placed upon the market a bright commercial motor vehicle. Two models are being produced, of 5 and 10 cwts. capacity. Arrangements have been made to produce 400 cars a week.

OWING TO THE continued low price of lead and abnormal market conditions, the Wanlockhead lead mines, which have for centuries maintained a happy and contented population, closed down on July 18, with the result that about 200 employees have been thrown idle.

THE EMPLOYEES of Carron Company at Carron Works, Mungal Foundry, engineering shop and Glasgow office have contributed for the half-year ending June 30, the sum of £553 3s. 6d. to infirmaries and other institutions in Edinburgh, Glasgow and Falkirk.

THE SOUTH AFRICAN STEEL & IRON INDUSTRIAL CORPORATION has placed with the English Electric Company, Limited, for the Pretoria steelworks, a contract for electrical equipment, including motors, transformers, switchgear, etc., aggregating 86,000 h.p. The contract is valued at £150,000.

THE PARTNERSHIP between Messrs. Hugh Currie, Arthur Dewhirst and David King, carrying on business as iron founders and patternmakers, at Progress Ironworks, Newgate, Mirfield, Yorkshire, under the style of Currie Dewhirst & King, has been dissolved. The business will be carried on in the future by the said Hugh Currie and Arthur Dewhirst, under the style or firm of Currie Dewhirst & King.

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE—a faculty of the University of London—has created a department of Business Administration under the control of Mr. J. Menker, M.A. Amongst those who have promised to participate in discussions are Sir William J. Larke, director of the National Federation of Iron and Steel Manufacturers, and Mr. F. C. Ihlee, of Messrs. Baker, Perkins, Limited.

THE PRINCIPAL of the Bradford Municipal Technical College (Mr. H. Richardson), having reported to the Technical Education Committee on the position with regard to the teaching of foundry work under the scheme of the Institute of British Foundrymen, has been authorised to arrange for the installation of the necessary foundry equipment. The West Yorkshire Branch of the Institute of British Foundrymen, which usually meets at the Bradford College, is keenly interested in the promotion of this teaching for the young men of the craft in the West Riding.

IN THE COURSE of his speech at the shareholders' meeting of Messrs. Braithwaite & Company Engineers, Limited, Mr. J. H. Humphreys (the chairman of the company) said that, in addition to the ordinary run of structural work, the company specialised in certain forms of construction and possessed patented plant. Much attention was being paid to the development of specialities—plant and method—and to the cultivation of overseas markets. The first result had been the booking of the bridgework contract in Northern Rhodesia, the piers of which were being constructed by the company's "Screwcrete" method. It was anticipated that, when this method of construction became known to engineers generally, a satisfactory volume of orders should result.

AT THE GENERAL MEETING of the Skoda Works of Plzen, Czecho-Slovakia, recently, accounts were submitted showing net profits for 1930 of 67,831,252 kr., which is slightly higher than the figure for 1929, namely, 67,080,873 kr. The statutory dividend of 5 per cent. took 10,000,000 kr., the statutory directors' fees of 10 per cent. amounted to 5,783,125 kr., while a "super-dividend" of 74 kr. a share was again declared, requiring 46,250,000 kr., and 5,000,000 kr. was again set aside for distribution to staff. The carry-forward was increased from 1,044,082 kr. to 1,842,208 kr. The report states that, thanks to previous preparations, the world economic depression is not in any way reflected in the figures for last year's activities of the works. The turnover invoiced in 1930 is higher than that of the previous year. The capital expenditure programme of several years has been finally realised, in its chief points, in the course of last year. The exchange rate is 164 Czech crowns to the £.

Obituary.

MR. GEORGE J. MASSEY, who was in charge of the engineering section of Callender's Cable & Construction Company's works at Belvedere, Kent, died recently.

MR. HENRY NICHOLSON, of Warkworth House, Newburn, has died at the age of 85. He served his apprenticeship as a moulder at the Newburn Steel Works (John Spencer & Sons (1928), Limited), and rose to the position of manager. He retired in 1910 after having spent 50 years in the service of the firm.

MR. THOMAS CARSON died at his residence, 119, Clyde Street, Carluke, on July 17. Mr. Carson, who was in his 55th year, served his apprenticeship as a moulder with Messrs. Russell & Company at their Whiteshaw Foundry. He remained in the employment of the firm for a number of years, and latterly was employed in the foundry of Coltness Iron Company, Limited, Newmains.

AS BRIEFLY ANNOUNCED in our last issue, Dr. E. G. Acheson recently died in New York at the age of 75. His early experience was in the electrical profession, and at one time he was an assistant draughtsman for Thomas A. Edison, but his inventive faculties were soon actively engaged in development work on lamp filaments. In 1890, he founded the Monongahela Electric Light Company. While working on the reduction of iron ore, Acheson had noticed that clay objects placed within the furnace became impregnated with carbon and seemed harder as a result. He then endeavoured to determine the effect of the higher temperatures, obtainable electrically at his power plant in Monongahela, upon similar clay-carbon mixtures. The experiment yielded a new chemical compound, silicon carbide (SiC_2), now known commercially as "carborundum." This material was found to possess a hardness approaching the diamond, and was particularly valuable as an abrasive. In 1891 the Carborundum Company was formed at Monongahela. Upon subjecting carborundum to very high temperatures, Acheson found that it decomposed, the silicon volatilising and leaving a residue of graphitic carbon. Analysis showed this man-made graphite to be of the highest purity. In 1899, Acheson-graphite became an article of commerce with the formation of the Acheson Graphite Company. In 1901, while endeavouring to utilise his graphite in crucible manufacture, Acheson sought the use of clay as a binder. During the course of this work he discovered a method of improving the plasticity of clays by a process which was the forerunner of his production of colloidal graphite five years later. To co-ordinate the various interests and activities of Dr. Acheson the Acheson Corporation was formed in 1915 and the Goodrich Corporation in 1925. Dr. Acheson founded, in 1928, the Edward Goodrich Acheson Fund, which, under the control of the American Electrochemical Society, provides a cash prize and the Edward Goodrich Acheson Medal "to the person who, in the judgment of the directors of the Society . . . shall have made such contribution to the advancement of any of the objects, purposes or activities . . . fostered or promoted by the Society . . . as to merit such an award." The Society unanimously voted Dr. Acheson the first recipient of his own medal for his contributions to electro-thermics.

U.S. Tariff Commission's Report on Pig-iron.—The U.S. President has approved the findings of the Tariff Commission which indicates that no change should be made at this time in the duty of $1.12½ per ton on iron in pigs. This investigation was instituted in response to a Senate Resolution. British India, which since 1926 has supplied about 50 per cent. of the total imports of iron in pigs from all countries, was found to be the chief competing country.

Personal.

MR. ARTHUR DORMAN has been elected vice-chairman of Messrs. Dorman, Long & Company, Limited.

MR. ARTHUR JAMES has been appointed to the position of assistant general manager of the Monmouthshire branch of Messrs. Baldwins, Limited.

MR. DAVID LEITCH, who has been chief warehouseman with Messrs. Dobbie Forbes & Company, Limited, Larbert Foundry, for the past 47 years, has just retired.

MR. D. THOMSON, for many years connected with Messrs. Brown, Bayley & Company, Limited, has been appointed general manager of the Monmouthshire branch of Messrs. Baldwins, Limited.

MR. E. J. FOX (managing director of Stanton Ironworks Company, Limited) has accepted the presidency of the recently-established British Works Management Association, 68, Victoria Street, London, S.W.1.

CAPTAIN H. LEIGHTON DAVIES, at his request, is being relieved of the direct management of the Monmouthshire works of Messrs. Baldwins, Limited, and will devote the whole of his time to the tinplate and steel section of the company's business.

Wills.

HAIGH, P., director of John Haigh & Sons, Limited, ironfounders and textile engineers, Huddersfield ... £120,239

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

15,370. JOHANSSON, A. Device for pouring molten metal into a mould. 348,398.

17,917. FIRTH-STERLING STEEL COMPANY. Ingot moulds. 348,426.

35,616. TRIGGS, W. W. (American Cyanamid Company). Case-hardening of metals. 349,547.

4,920. CLAMER, G. H. Refining of metals in electric inductor furnaces. 349,446.

5,238. HALASZ, J. Electric shaft furnace for treating metal scrap or ores. 349,449.

5,824. CARTER, R. W. Surface treatment of aluminium and aluminium alloys. 349,596.

6,074 AKT.-GES. DER EISEN- UND STAHLWERKE VORM. G. FISCHER, and MESSINGWERK SCHWARZWALD AKT.-GES. Producing self-improving aluminium alloys. 349,463.

6,840. WHITE, A. E. (Doherty Research Company). Method of and apparatus for producing molten and refined metals from their crude ores. 349,625.

7,704. BLYTHE, H. B. Furnaces for wire heating. 349,671.

13,448. WELLMAN SMITH OWEN ENGINEERING CORPORATION, LIMITED, and SOWARD, H. W. Furnaces for the melting of metals and the heat-treatment of metal objects. 349,745.

16,655. HERAEUS VACUUMSCHMELZE AKT.-GES., and ROHN, W. Cooling moulds for casting metals. 349,779.

Contracts Open.

Athlone, Ireland, September 2.—Three centrifugal pumps, etc., for the Urban District Council. Mr. D. McAteer, consulting engineer, 3, Westmoreland Street, Dublin.

Calcutta, August 17.—Generator and centrifugal pump, for Indian Stores Department. The Department of Overseas Trade. (Reference A.X. 11,026.)

Gueziret-Chandawel, September 15.—Centrifugal pump, etc., for the Egyptian Ministry of the Interior (Municipalities and Local Commissions Section). The Department of Overseas Trade. (Reference G.X. 10,561.)

Johannesburg, August 31, 1931. — Pig-iron (approved brands) for the period January 1 to June 30, 1932, for the South African railways and harbours. Department of Overseas Trade, 35, Old Queen Street, London. (Reference G.X. 10,606.)

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Quiet conditions are prevalent in the Cleveland iron market, and at the moment there seems little prospect of an immediate change for the better. Despite the fact that a few small sales of Cleveland foundry iron to Continental consumers have been arranged by merchants who favourably regard the prospects of further small orders, extraneous events, such as the holidays in Scotland and the financial crisis in Central Europe, exercise a paralysing influence upon the iron and steel trade generally. The consuming works have, as a rule, small reserves of iron, and they are consequently bound to make small purchases from time to time. Less Continental iron is now coming into the Tees, but the arrival of Midlands iron at local works continues unchecked. The Midlands ironmasters have their own fixed zone prices, but they are actually paying over 12s. per ton carriage and delivering foundry iron in the Cleveland district at about 56s. per ton. This, of course, represents surplus output, and such offers would no doubt be withdrawn if a better home demand developed. Meanwhile, however, the Cleveland makers insist that their own prices are only at a reasonable level, and they prefer to take iron into stock for a time rather than sell at a heavy loss. Thus, the fixed official minima to all destinations except Scotland are left unchanged, as follow :—No. 1 foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

Conditions in the East Coast hematite market are perhaps more satisfactory. Notwithstanding the depression in the steel trade, there is a steady volume of business for East Coast hematite. Its relative cheapness has enabled makers to secure additional bookings for Sheffield and the Midlands. Further export sales to Italy and Holland are also reported. Prices, of course, are at an unsatisfactory level. Probably 62s. per ton does not cover the cost of producing mixed numbers, and, although that is still the quoted figure for mixed numbers, it is not the minimum which would be accepted for a good order. It may be noted, however, that makers are less inclined to discuss forward contracts except at a small premium, implying a growing confidence in the future position. Bessemer mixed numbers on the North-West Coast remain at 66s. at works.

LANCASHIRE.—The recent slight improvement in the demand for pig-iron in this area is maintained, the consumption of certain sections of the foundry trade having improved. The market is still largely influenced by the depression in the textile-machinery trade in particular, and by the difficult position of the heavy industries in general. Prices remain unaltered. For delivery to users in the Manchester price zone, Staffordshire, Derbyshire and North-East Coast brands of No. 3 iron are on offer at round 67s. per ton, with Northamptonshire pig-iron at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at from about 87s. to 87s. 6d., and West Coast hematite iron at round 81s. per ton.

MIDLANDS.—This market remains quiet. There is still no sign of any change in the position of the heavy industries. The recent improvement in certain light trades is maintained, but orders are still chiefly for small quantities to cover immediate needs. For delivery to Birmingham and Black Country stations the furnaces still quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Little business has been done during the past week, owing to the Glasgow Fair holidays. The production of Scottish pig-iron is now very restricted. Scottish pig-iron makers are quoting as a fixed minimum price 71s. per ton for No. 3 foundry, f.o.t. furnaces, with a minimum of 2s. 6d. per ton extra for No. 1. The price of Continental No. 3 is 53s., f.o.t. Grangemouth.

Finished Iron.

The position in the market for finished iron is still very gloomy, and those mills that are still in operation are working only spasmodically. Quotations for crown bars still vary from £9 5s. to £10, with nut and bolt iron at £8 10s. to £8 12s. 6d. Staffordshire marked bars remain at £12. For common nut and bolt work the foreign product is being purchased, the present price delivered to Black Country works being between £4 15s. and £4 17s. 6d.

Steel.

Little business is passing in the finished-steel market, orders being few and far between, and, in all cases, for very small amounts. The disturbed financial situation is restricting overseas business. A few small orders have been placed for galvanised sheets, but there is little activity in this section of the trade. Very little business is moving in semi-finished material, the demand being seriously affected by the dearth of business for sheets and bars.

Scrap.

The Cleveland market is still lifeless, and prices remain low, owing to competition between the merchants to secure what little business is passing. Ordinary heavy cast-iron is quoted at 41s., and good machinery quality at 43s. The demand in the Midlands market is still very poor. Heavy machinery scrap in cupola sizes is quoted at 47s. 6d., and light cast-iron at 37s. 6d., both delivered at works. The position is no better in other districts. In South Wales supplies are plentiful, and the works have no difficulty in obtaining all they require at the low prices now ruling.

Metals.

The non-ferrous metal markets are still suffering from the effects of the complications caused by the European financial troubles. Confidence has been, in many cases, shaken, and the general outlook is uncertain.

Copper.—The actual rate of consumption has been overshadowed by the economic situation on the Continent, but it seems fairly obvious that industrial conditions in the United States have not in any way improved, and the demand, therefore, offers little encouragement to those who predict a higher rate of copper consumption in the near future. At home the situation is no more encouraging to producers.

Closing quotations :—

Cash.—Thursday, £33 8s. 9d. to £33 10s.; Friday, £33 3s. 9d. to £33 5s.; Monday, £32 18s. 9d. to £33 1s. 3d.; Tuesday, £32 17s. 6d. to £33; Wednesday, £33 1s. 3d. to £33 3s. 9d.

Three Months.—Thursday, £34 5s. to £34 6s. 3d.; Friday, £34 to £34 2s. 6d.; Monday, £33 16s. 3d. to £33 17s. 6d.; Tuesday, £33 15s. to £33 16s. 3d.; Wednesday, £33 16s. 3d. to £33 18s. 9d.

Tin.—The statistical position depends on the development of consumption now that restriction is being practised, and, so far as can be judged, the outlook for consumption is not particularly promising. However, the price is low, and this must largely discount the adverse features. A fairly considerable reduction is expected in the near future in the supplies of ore from the Federated Malay States. Apart from the intensified rate of restriction commencing on June 1, Malaya has been exceeding its quota, and matters will need to be adjusted in the near future.

Official closing prices :—

Cash.—Thursday, £108 7s. 6d. to £108 10s.; Friday, £108 2s. 6d. to £108 5s.; Monday, £108 12s. 6d. to £108 15s.; Tuesday, £108 15s. to £108 17s. 6d.; Wednesday, £108 10s. to £108 12s. 6d.

Three Months.—Thursday, £110 7s. 6d. to £110 10s.; Friday, £110 5s. to £110 7s. 6d.; Monday, £110 12s. 6d. to £110 15s.; Tuesday, £110 17s. 6d. to £111; Wednesday, £110 12s. 6d. to £110 15s.

Spelter.—The influence of the Cartel's arrangement to restrict output, and the improved sentiment which might have been expected from such a decision have been largely discounted by the financial troubles abroad.

Daily fluctuations :—

Ordinary.—Thursday, £11 15s.; Friday, £12; Monday, £11 15s.; Tuesday, £11 17s. 6d.; Wednesday, £11 16s. 3d.

Lead.—A certain amount of business has been done, but the inquiry is not satisfactory. The future is rather obscure at the moment.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £12 11s. 3d.; Friday, £12 11s. 3d.; Monday, £12 10s.; Tuesday, £12 15s.; Wednesday, £12 11s. 3d.

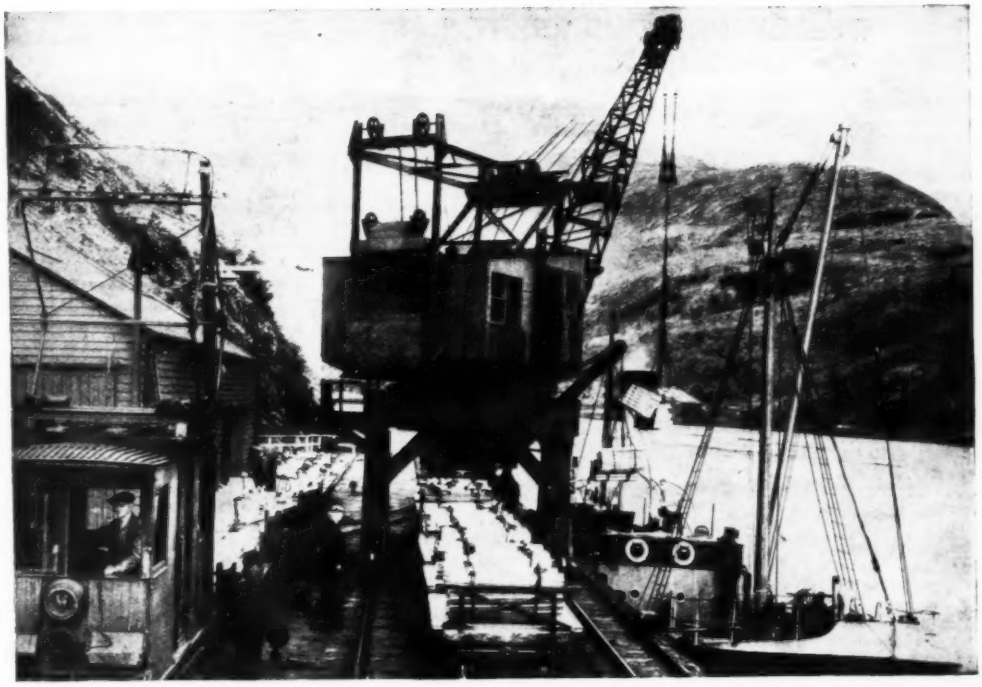
Publications Received.

The Midland Coke Research Committee has issued, from its headquarters at the Department of Fuel Technology of the University of Sheffield, a Progress Report for 1930. The main work of the Committee has been in the direction of the amelioration of blast-furnace coke. Naturally, the successful consummation of this work will react favourably on ironfoundry practice, and the liaison maintained by the Cast Iron Research Association is a wise step from this angle.

Nickel and Its Alloys in Chemical Plant. Published by the Bureau of Information on Nickel, the Mond Nickel Company, Limited, Imperial Chemical House, Millbank, London, S.W.1.

This publication is particularly welcome at the moment, as it comes at a time when the chemical manufacturing industries have been holding a jubilee conference and exhibition. The subject-matter is divided into three sections—Nickel, Monel Metal and Nickel-Chromium Corrosion-Resisting Steels. Unquestionably, the booklet reveals the absolute interdependency of the various branches of industry in which the foundry occupies not an inconsiderable part. It should be studied with care by recipients, as the requirements of the chemical industry are so diverse that it is impossible to predict which material is eventually going to "win through."

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone : 3852 (2 Lines). MIDDLESBROUGH. Telegrams : "Ritchie, Middlesbrough."



S.S. Loch Etive at Kinlochleven Wharf.

LOADING aluminium from one of the British Aluminium Company's three hydro-electric aluminium reduction works in the Highlands.

Aluminium is produced by the Company in notched bars (98-99% and higher purities) and alloy ingots, the latter to B.A.C. and British Standard Specifications.

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Suppliers of the finest

BLACKING

NO FINER BLACKING IS USED IN ANY FOUNDRY

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	33	1	3
Three months	33	16	3
Electrolytic	36	0	0
Tough	34	0	0
Best selected	34	5	0
Sheets	64	0	0
India	45	0	0
Wire bars	38	7	6
Do., September	38	7	6
Do., October	38	7	6
Ingot bars	38	7	6
H.C. wire rods	38	10	0
Off. av. cash, June	35	17	6 5/44
Do., 3 mths., June	36	10	10 1/11
Do., Sttlmnt., June	35	17	4 7/11
Do., Electro, June	39	7	10 1/11
Do., B.S., June	37	10	10
Do., wire bars, June	39	16	4 5/11
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7½d.
Wire	7½d.
Rolled metal	7d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN

	£	s.	d.
Standard cash	108	10	0
Three months	110	12	6
English	109	10	0
Bars	111	15	0
Straits	111	7	6
Australian	109	15	0
Eastern	113	2	6
Banca	113	5	0
Off. av. cash, June	105	0	8 2/11
Do., 3 mths., June	106	13	5 1/2
Do., Sttlmt., June	105	1	1 7/11

SPELTER.

	£	s.	d.
Ordinary	11	16	3
Remelted	11	0	0
Hard	9	0	0
Electro 99.9	14	0	0
English	12	7	6
India	11	0	0
Zinc dust	19	0	0
Zinc ashes	3	0	0
Off. aver., June	11	10	2 17/44
Aver. spot, June	11	5	4 1/22

LEAD.

	£	s.	d.
Soft foreign ppt.	12	11	3
English	14	0	0
Off. average, June	11	15	4 1/11
Average spot, June	11	11	7 11/22

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	20	10	0
Do., V.M. ex-whf.	19	5	0
Rods	22	0	0
Boiler plates	14	0	0
Battery plates	15	10	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	34	0	0
Chinese	22	5	0
Crude	21	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	16	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 7 6
45/50%	£10 7 6
75%	£15 2 6
Ferro-vanadium—	
35/50%	2/8 lb Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9½d. lb.
Ferro-phosphorus, 20/25%	£15 10 0
Ferro-tungsten—	
80/85%	1/8½ lb.
Tungsten metal powder—	
98/99%	1/11½ lb.
Ferro-chrome—	
2/4% car.	£28 0 0
4/6% car.	£21 5 0
6/8% car.	£20 12 6
8/10% car.	£19 17 6
Ferro-chrome—	
Max. 2% car.	£29 17 6
Max. 1% car.	£33 15 0
Max. 0·70% car.	£35 12 6
70%, carbon-free	9½d. lb.
Nickel—99% £170 0 0 to £175 0 0	
Ferro-cobalt	8/9 lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose £10 15 0 to £11 5 0	
76/80% packed £11 15 0 to £12 5 0	
76/80% export (nom.) £ 9 0 0	
Metallic manganese—	
94/96% carbonless	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/64 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

South Wales	£	s.	d.	£	s.	d.
Heavy steel				2	0	0
Bundled steel and shrngs.	1	14	0	to 1	18	0
Mixed iron and steel	1	14	0	to 1	16	0
Heavy cast iron	2	0	0	to 2	2	6
Good machinery for foundries				2	5	0

Cleveland—	£	s.	d.
Heavy steel	1	17	6
Steel turnings	1	5	0
Cast-iron borings	1	2	0
Heavy forge	2	13	0
W.I. piling scrap	2	10	0
Cast-iron scrap	2 1 0	to 2	3	0

Midlands—	£	s.	d.
Light cast-iron scrap	1	17	6
Heavy wrought	2	7	6
Steel turnings		—	

Scotland—	£	s.	d.
Heavy steel	1	17	6
Ordinary cast iron	2	3	0
Engineers' turnings	1	5	0
Cast-iron borings	1	10	0
Wrought-iron piling	2	7	6
Heavy machinery	2	8	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	27	0	0
Brass	18	0	0
Lead (less usual draft)	10	0	0
Tea lead	7	0	0
Zinc	6	0	0
New aluminium cuttings	52	0	0
Braziery copper	24	0	0
Gunmetal	23	0	0
Hollow pewter	72	0	0
Shaped black pewter	53	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	62/6
Hematite M/Nos.	62/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	71/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands—	
Staffs common*	—
,, No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	73/6
,, No. 3	71/-
Hem. M/Nos. d/d	70/-
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	76/-
W.C. hematite	82/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/6
Clyde, No. 3	87/6
Monkland, No. 3	87/6
Summerlee, No. 3	87/6
Eglinton, No. 3	87/6
Gartsherrie, No. 3	87/6
Shotts, No. 3	87/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	15	0	to 10	0	0
Nut and bolt iron	8	10	0	to 8	12	6
Hoops	10	10	0	to 12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0	to 12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	5	0

Steel—	£	s.	d.	£	s.	d.
Plates, ship, etc.	8	15	0	to 8	17	6
Boiler plts.	9	0	0	to 9	15	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¼ in. (Untested)	6	12	6	& up.		
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0	to 8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	5	0
Black sheets, 24g.	8	5	0	to 9	5	0
Galv.cor.shts.24g.	9	7	6	to 9	15	0
Galv. flat sheets	10	0	0	to 10	5	0
Galv. fencing wire, 8g. plain				12	0	0
Billets, soft	4	17	6	to 5	7	6
Billets, hard				6	12	6
Sheet bars	4	12	6	to 4	17	6
Tin bars				4	12	6

PHOSPHOR BRONZE.

Per lb. basis.

Strip	10½d.
Sheet to 10 w.g.	12d.
Wire	12d.
Rods	11½d.
Tubes	1/6d.
Castings	11½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

Per lb.

Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/- to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.01
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	12.00
Basic	17.26
Bessemer	18.76
Malleable	18.76
Grey forge	18.26
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.65
Tank plates	1.65
Beams, etc.	1.65
Skelp, grooved steel	1.65
Skelp, sheared steel	1.65
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.80
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	22/6 to 25/-
,, furnace	14/- to 15/-
Durham and Northumberland—	
,, foundry	13/-
,, furnace	13/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	13/6
,,	28×20 ,,	27/-
,,	20×10 ,,	20/-
,,	18¾×14 ,,	14/6
C.W.	20×14 ,,	13/-
,,	28×20 ,,	27/-
,,	20×10 ,,	19/7½
,,	18¾×14 ,,	14/6
Terneplates	28×20	27/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars and rods dead soft, st'l	£11 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
July	23 ..	33	8	9	dec.	13/9
,,	24 ..	33	3	9	,,	5/-
,,	27 ..	32	18	9	,,	5/-
,,	28 ..	32	17	6	,,	1/3
,,	29 ..	33	1	3	inc.	3/9

Electrolytic Copper.

		£	s.	d.		
July	23 ..	36	10	0	dec.	10/-
,,	24 ..	36	10	0	No change	
,,	27 ..	36	10	0	,, ,,	
,,	28 ..	36	0	0	dec.	10/-
,,	29 ..	36	0	0	No change	

Standard Tin (cash).

		£	s.	d.		
July	23 ..	108	7	6	dec.	40/-
,,	24 ..	108	2	6	,,	5/-
,,	27 ..	108	12	6	inc.	10/-
,,	28 ..	108	15	0	,,	2/6
,,	29 ..	108	10	0	dec.	5/-

Tin (English ingots).

		£	s.	d.		
July	23 ..	109	10	0	dec.	35/-
,,	24 ..	109	5	0	,,	5/-
,,	27 ..	109	15	0	inc.	10/-
,,	28 ..	109	15	0	No change	
,,	29 ..	109	10	0	dec.	5/-

Zinc Sheets (English).

		£	s.	d.		
July	23 ..	20	10	0	No	change
,,	24 ..	20	10	0	,,	,,
,,	27 ..	20	10	0	,,	,,
,,	28 ..	20	10	0	,,	,,
,,	29 ..	20	10	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
July	23 ..	11	15	0	dec.	11/3
,,	24 ..	12	0	0	inc.	5/-
,,	27 ..	11	15	0	dec.	5/-
,,	28 ..	11	17	6	inc.	2/6
,,	29 ..	11	16	3	dec.	1/3

Lead (English).

		£	s.	d.		
July	23 ..	14	0	0	dec.	5/-
,,	24 ..	14	0	0	No change	
,,	27 ..	14	0	0	,,	,,
,,	28 ..	14	0	0	,,	,,
,,	29 ..	14	0	0	,,	,,

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895	5 15 0	5 15 0	5 12 6	5 12 6	5 15 0	5 17 6	5 15 0	5 17 6	6 0 0	6 0 0	6 2 6	6 0 0	5 16 10½
1896	6 0 0	6 0 0	6 2 6	6 2 6	6 2 6	6 0 0	6 0 0	6 0 0	6 0 0	6 2 6	6 10 0	6 10 0	6 2 6
1897	6 10 0	6 10 0	6 10 0	6 7 6	6 2 6	6 2 6	6 5 0	6 0 0	6 0 0	6 0 0	6 7 6	6 10 0	6 5 5
1898	6 10 0	6 8 9	6 8 9	6 10 0	6 15 0	6 18 9	6 17 6	6 17 6	7 2 6	6 15 0	7 0 0	7 5 0	6 15 8½
1899	7 5 0	8 0 0	8 2 6	8 2 6	8 5 0	8 5 0	8 12 6	8 12 6	8 15 0	8 15 0	9 2 6	9 5 0	8 17 8½
1900	9 5 0	9 5 0	9 7 6	9 10 0	9 12 6	10 5 0	10 5 0	10 5 0	10 5 0	10 0 0	9 15 0	9 15 0	9 15 10
1901	9 5 0	9 5 0	8 15 0	8 10 0	8 10 0	7 10 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 3 11
1902	7 7 6	7 0 0	7 12 6	7 12 6	7 12 6	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 9 7
1903	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 3 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920	26 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 10 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	11 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 7	10 6 8½
1930	10 2 9	10 3 5½	10 3 9	10 3 9	10 3 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	9 16 3	10 1 6½
1931	9 15 0	9 15 0	9 15 0	9 10 11	9 6 9	9 5 0	—	—	—	—	—	—	—

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WANTED, Qualified Metallurgist, to take control of ironfounders' laboratory.—Apply by letter, giving age and full particulars of experience and qualifications, to Box 852, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, Single Man, confidential assistant, general office management, costing, sales, etc. Must have some technical experience, preferably in light castings ironfounding. No others need apply.—Box 856, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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Jackman Rotary Sifter	£8

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